THE OIL WEEKLY

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The Oil Man's Calendar

NOV. 6	California Natural Gasoline Association, Los Angeles.
9–13	American Petroleum Institute, Palmer House, Chicago.
16–18	American Institute of Chemical Engineers, Netherlands Plaza Hotel, Cincinnati.
17–21	National Chemical Exposition, and Industrial Conference, American Chemical Society, Chicago.
19–20	American Association of Oilwell Drilling Contractors, Tulsa.
DEC. 2	New Mexico Oil and Gas Association, Artesia Hotel, Artesia.

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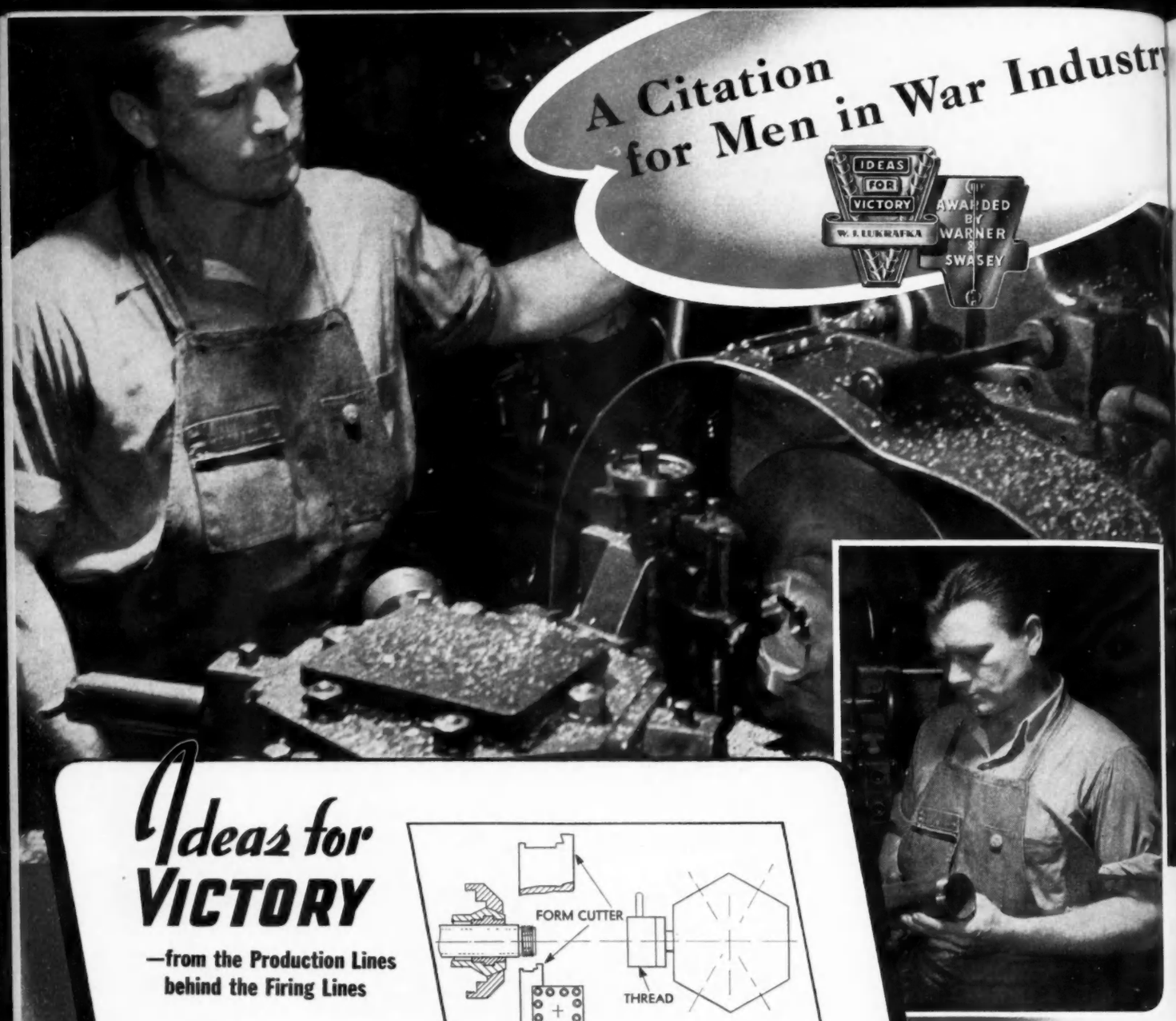
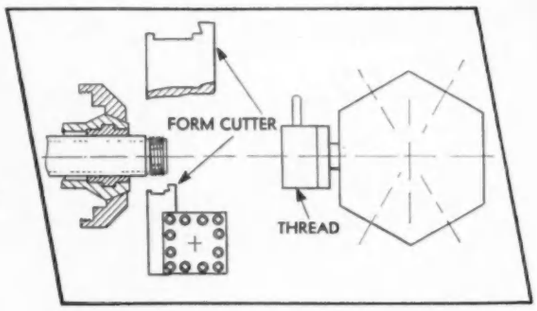


Ideas for VICTORY

—from the Production Lines behind the Firing Lines



He Increased Production 33⅓% by Developing a Forming Tool

Operator W. J. Lukrafka who works for the A. W. Cash Company, Decatur, Ill., was turning a brass tubing job with two knee tools and a die head in the hex cutter and a facing tool in the cross slide.

The sketch shows how by developing a forming tool, he was able to combine the turning and facing cuts into one operation from the cross slide. The die head completed the job. Indexing was eliminated. Time saved! Production stepped up a third!

Many such ideas from patriotic operators are sent to us. In recognition of their initiative and resourcefulness, we are proud to present these men with a gold Victory pin. These "Ideas for Victory" are published in "Blue Chips", a shop bulletin sent free by Warner & Swasey to thousands of turret lathe operators. Make sure your operators are getting "Blue Chips" at their homes. Write Warner & Swasey, Cleveland, Ohio.

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WARNER & SWASEY FOR VICTORY

The Changing Panorama

Reserves Is Problem Of Most Concern

THE problem of reversing the downward trend of petroleum discoveries is rapidly assuming major importance, not only in oil circles but among government agencies. The widespread airing that the subject has received recently, especially in the past two weeks, indicates that the problems of oil will get more consideration in the future. This development indicates that the industry has a good chance of not only obtaining higher prices, but probably will be among the first industries to obtain some relaxation of regulations governing purchase and use of steel materials. Moreover, centralization of government control over oil may be still another result.

Admittedly, if the United States is to be assured of an adequate future producible supply of crude oil, it appears that wildcatting must be stimulated for the purpose of finding new supplies and also that the producing capacity of proven fields must be enlarged by additional development. The latter phase includes installation of secondary-recovery methods, keeping of stripper wells in operation, etc.

The past two weeks have seen many favorable developments. As William P. Cole resigned from Congress he gave President Roosevelt a full report on the oil situation. The attention of Congress was called to the industry's problems by the O'Mahoney investigating committee. Harold L. Ickes and other members of OPC have openly discussed the fear that unless something is done, there will be an inadequate supply of oil. The Independent Petroleum Association of America's annual meeting heard practically nothing else but remarks on the subject.

Such widespread attention should result in the problem of oil getting more consideration. With almost unanimous opinion higher crude oil prices are considered vital. The one exception is OPA, consequently higher price schedules have not been approved—yet. However, the pressure that is being exerted may force OPA to change its attitude, or accept the responsibility for any shortage that may develop later. Of course, the industry must also have additional operating materials if it is to expand its operations. The outlook for larger steel allocations is dismal, due to the growing war needs—but oil is moving steadily closer to the most preferred circles of work, and will be among the first industries to benefit from any easing of the steel situation. Almost everyone also thinks that centralized control, in place of the numerous government agencies now interested in oil, would help the situation.

Because of the attention the industry is receiving at present, some important developments of the nature outlined may be forthcoming.

Is it possible that the Axis troops in Africa are being pinched for oil? During the past few days three Axis tankers en route to Africa were sunk by United Nations' planes. There seems to be a possibility that Rommel's forces are getting short of fuel—with a major tank battle just beginning to shape up.

Some Speculation on Mexican Pipe Line

CIRCUMSTANCES lend weight to the talk which is being revived of laying a pipe line in Mexico either from Mexico City to Acapulco on the Pacific Coast, or across the Isthmus of Tehauntepec from Puerto Mexico on the Gulf of Salina Cruz on the Pacific.

Large requirements of oil by the United Nations in the Pacific are putting a strain on California's producing ability, while Mexico needs markets to replace those shut off by the shortage of tankers from Gulf terminals. Mexico's heavy oils are particularly fitted for the Pacific needs of the United Nations, of which Mexico itself is one. But there is not at present any pipe line across Mexico to the Pacific.

There is a 10-inch line from the eastern coast up to Mexico City, which has been operating for several years, but it is reported to be in bad condition, and it already is serving the purpose of supplying the Mexico City area. Considerable mountain construction would be encountered in laying a line from Mexico City to the Pacific, whereas the grade of a line across the Isthmus would likely follow a railroad built many years ago, before the construction of the Panama Canal. Less line would be involved in the Isthmus route than from Mexico City to Acapulco (150 miles against about 180), although Acapulco would offer a better harbor—one of the finest on the West Coast of North America.

Any pipe line laid in Mexico at this time would have to be built of pipe obtained in the United States, and in view of the steel shortage, the pipe hardly could be provided except by taking up a line. However, the mileage involved appears low enough to bring the project well within the limits of practicability, despite the fact that re-location of American lines already has put many idle or little-used lines into wartime service.

A Report on the Rubber Program

AN encouraging picture of the synthetic-rubber situation, particularly from the technician's standpoint, a picture which indicates that the program is further along than the public generally has been led to believe, is contained in the October issue of PETROLEUM REFINER, a technical journal devoted to refining and a sister publication of THE OIL WEEKLY.

Practically all of the 420 pages in the magazine deal with synthetic rubber, its history and technical problems. From an array of articles, written by outstanding authorities, the following important points of interest can be drawn:

The construction program is moving rapidly and with proper allocation of steel and other materials, the necessary plants for producing synthetic rubber ingredients will be completed on or before schedule;

The output of many of the new plants will run considerably greater than had been anticipated when the plans were first blue-printed;

Technical staffs will be adequate to handle production of the necessary ingredients;

New problems of metallurgy and of storage are being worked out rapidly;

The synthetic-rubber industry is here to stay, and will furnish specialty products in many instances better than natural crude rubber. However, natural rubber will not be eliminated from the picture.

We wonder if Marshal Petain, with the tendency of the aged toward reminiscences, does not recall his gallant days at Verdun when he reads of the defense of Stalingrad. "They shall not pass" was the watchword of Verdun, and it seems to have been revived in Russia a quarter of a century later while Petain's collaboration government seeks to aid the foe which he then so valiantly resisted.

API Prepares for War Program

THE annual meeting of the American Petroleum Institute, to be held in Chicago on November 9-12, will be a war convention of the industry. All three general sessions and most of the nine group sessions will be devoted to the wartime operation of the industry.

Practically all officials of OPC will take part in the program. Included in this group will be Petroleum Coordinator Harold L. Ickes, Deputy Petroleum Coordinator Ralph K. Davies, the three assistant deputy coordinators, the chief counsel, two special assistants, and the directors of production, natural gas and natural gasoline, transportation, marketing, petroleum supply, materials, foreign, reserves, research, public relations and facility-security divisions.

Joseph B. Eastman, director of the Office of Defense Transportation, will address a special evening session.

Sessions will be held on the protection of petroleum facilities during war, on wartime automotive transportation problems, on manufacture of synthetic rubber, on drilling and production problems created by the war, and other similar phases.

Would Speed Up Fuel Loading for Planes

IN THIS war, time is measured in human lives, and minutes saved in fueling or oiling an airplane may mean American lives saved. Consequently, Charles W. McAllister, aviation lubrication engineer of Sinclair Refining Company, New York, addressing the National Fuels and Lubricants meeting of the Society of Automotive Engineers at Tulsa last week, recommended improved, more efficient lubricating oil tank trucks for servicing the large war planes. Similar trucks also will be needed, he said, for servicing the air-transport planes of tomorrow.

The truck unit proposed would be built on a conventional motor truck chassis, equipped to handle both draining and reoiling, have tank capacities of 600 gallons of new oil and 400 gallons of drainage oil, and be equipped with elevating platform from which fill and drain plugs of largest planes could be reached without climbing about the plane or using ladders. A full barrel of lubricating oil would be put into the plane every 2 or 3 minutes by using short lengths of hose of large capacity, accurate measuring gages, and heating elements to keep the oil thoroughly fluid. Draining would be equally fast, and accommodate 2 or more engines simultaneously.

The described oil-tank truck and other time - saving ground - servicing equipment are essential, the speaker declared, because effective operation of a large fleet of transport planes will necessitate analysis of every plane maintenance job and setting up of a time allowable for each operation.

Figures Point to Aviation Needs

GREATER and greater quantities of aviation gasoline and aviation lubricants evidently will have to be supplied by the American oil industry. This is the conclusion logically to be drawn from information officially revealed on military aims. The air force is scheduled to have at the end of 1943 nearly 40 percent of the United States combat troops, or 2,200,000 out of 5,700,000, although the ground army at that time will be less than half as large as Germany's. (Secretary Stimson's figure of 7,500,000 men included supply and training troops.)

The announced, upward-revised goal for production of airplanes in 1942 is 60,000; and that for 1943 is 120,000. Each passing month sees more planes in the air and more aviation gasoline and lubricants required.

Putting these signs together, laymen foresee the possibility that the United Nations will make their invasion of Europe primarily an unprecedented and truer blitzkrieg—a war of lightning from the skies, calculated to bomb Germany to defeat, with a rain of bombs more terrible than any that Hitler ever found words to describe, in threatening what the Luftwaffe would do to England or other countries.

AXists

The zealot with "God Bless America" blazoned on the car he drives at 60 miles per hour.

• • •

The merry-go-round patriot who ostentatiously buys bonds every payday and after two months as regularly converts them to cash.

• • •

The parent who presents all tires in excess of five to the children to play with, and then impounds them until the "kids are old enough to appreciate 'em."

• • •

The prattling Polly whose 'phone calls clog an overburdened trunk line.

• • •

The politician who thinks that talking now can win the war—or votes.

Oil to Lose Some More Volume

WHILE the oil industry faces curtailed market for gasoline through national rationing, it also is confronted with the possibility of a substantial loss of market for gasoline, kerosine, lubricants, and greases in agriculture, due to the passing of many farms into idleness, as farm workers and farmers go into military service and war industries. It has been estimated that in Kansas alone over 10,000 farms will cease to be operated during the coming winter and therefore grow weeds next spring instead of wheat, corn, and other crops.

Put This in a Jar!

A display at the recent annual meeting of the National Stripper Well Association showed the following comparison of wholesale prices by means of gallon glass jugs:

Crude oil	*3 cents per gallon*
Milk	*52 cents per gallon*
Beer	*65 cents per gallon*
Soft drinks $1.80	*per gallon*

No Shortage of Oil For Rubber Needs

EVEN at this late date of large and growing dangers to the nation, group and individual interests are reluctantly subordinated to the national safety, as evidenced by activity in connection with synthetic-rubber production. Current talk of potential oil shortage is being seized upon as ammunition for gaining greater participation of farm-distilling interests in the synthetic-rubber program.

Those groups suggest that in order to conserve petroleum, some of the scheduled production of butadiene should be diverted from oil refineries to plants that would produce the rubber ingredient from alcohol from grain.

Actually, even if all the contemplated synthetic rubber production were based on petroleum as the source, the program would eat into the nation's petroleum supplies like a lone bird into a field of wheat. If a million tons of synthetic-rubber production per year represented nothing but petroleum changed into another form, or in other words a million tons of petroleum, the amount of the petroleum in more familiar measure would be about 7,000,000 barrels annually. That quantity is equivalent to ½ of 1 percent of the 1,404,182,000 barrels of crude oil produced in the United States in 1941.

☆ ☆ ☆ ☆ WASHINGTON ROUNDUP ☆ ☆ ☆ ☆

By B. F. LINZ
Washington Correspondent

»

War Production Board's Approval Given Big Line Extension

»

President Has "Central Authority" Question Under Study

»

Deferment of Gasoline Rationing Turned Down by Administrators

☆ ☆ ☆ ☆

OUTSTANDING event of the oil week in Washington was the final retreat of the War Production Board from its position of opposition to the big-inch pipe line, signified in its approval of Coordinator Ickes' request for the allocation of steel for completion of the project from Norris City, Ilinois, to the East Coast.

Immediately, Ickes made it known that he would agitate for a second through line, to carry products from the Texas refineries to the Seaboard, but said he would not make formal application until the board had committed itself so deeply to the big-inch line that it could not back out. To do otherwise, the coordinator said, would be "poor psychology."

Major talking point for pipes to the East was that it would not do any good to produce planes for operation in the European theatre of war unless at the same time an adequate supply of fuel and lubricants was provided and shipped.

The oil situation, Ickes said October 29, is "desperate," bearing out forecasts made more than two years ago that in the event of an emergency there would be a shortage of oil transportation to the Atlantic States.

The big-inch line, he said, would relieve the equivalent of 70 tankers; the proposed products line, which probably will be of smaller diameter, will release more ships, all of which can be used for war transportation. The latter, he said, should be built as soon as possible. "We are going to need it," he predicted.

Evidence of the uncertainty of present methods of transportation was given in figures on train deliveries of oil to the East Coast during the week ended October 24, when they dropped 78,924 barrels a day from the preceding week to an average of $759,233 barrels daily. Floods and train wrecks contributed to the decline. There were 1138 carloads of oil and products delivered to New England points during the week, against the 1300 cars which OPC aims at to provide that area with 75 percent of last year's consumption.

In the works at the week end was an amendment to OPC Recommendation 47 looking to the plugging of wells to permit the removal of equipment to other sites. OPC plans to make a survey of wells to determine which can be plugged without losing the underground oil, and proposes to move the equipment of such wells to use where it will result in increased production.

Wells to be closed down would, of course, be small producers, but even so OPC will not suspend their operation if it is likely to result in loss of underground reserves.

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FIGHT: Relations between Coordinator Ickes and WPB Director Donald M. Nelson, rarely describable as less than strained almost from the inception of the board, took a turn for the worse during the week.

Cause of the new rupture was a WPB order halting all governmental construction except projects defined by the board as essential. Issued without consultation with the Interior Department, the ban covered new construction under way in the government's helium reserve at Amarillo, Texas, and a number of power projects designed to feed northwestern naval and war industry areas.

Ickes immediately telegraphed the Army and Navy of the helium situation, and they got to work on WPB, to which also he addressed a letter suggesting that it might be desirable to reconsider these projects and exempt them. One week later, he was still without response from the Nelson organization.

But he did not stop construction at Amarillo.

☆

WILDCATTING: Suggestions of the O'Mahoney oil committee that Reconstruction Finance Corporation might finance wildcatting aroused no particular enthusiasm in OPC, where Coordinator Ickes saw difficulties in any such plan, although admitting that everything possible should be done to encourage increased exploration.

RFC financing, the coordinator suggested, might well be the entering wedge for all-out government control of the oil industry, with any new areas discovered thrown into the Naval reserves. At the same time, he expressed doubt of the authority of RFC to undertake to finance private speculative enterprise.

Extension of Big Line to Atlantic Seaboard Gets Go Ahead From War Production Board

MORE than 15 months of effort on the part of Coordinator Ickes was crowned with success October 27 when the War Production Board, after months of backing and filling, authorized completion of the big-inch pipe line from Longview, Texas, to the New York-Philadelphia refinery area.

Elated over his success in finally securing action on the big line, Ickes immediately began agitation for another line to parallel it, contending that it would release ocean-going tankers which will be needed to carry the war to the enemy.

With all opposition to the line ironed out (THE OIL WEEKLY, October 26) WPB approved extension from Norris

City, Illinois, to the seaboard, and allocated 219,000 tons of steel for the main tube and 5000 tons for branches.

Work on the second and longer section of the line will start as soon as construction of the leg to Norris City is completed, probably in December. Construction crews now laying the 531-mile section will be switched to the 857-mile extension which eventually will bring 300,000 barrels of crude oil a day from the East Texas area to the Eastern refineries.

Construction of the first section of the line was authorized by WPB last June 10 with an allocation of 125,000 tons of steel, and was underwritten by Reconstruction Finance Corporation to the extent of $35,000,000. The section now authorized will cost $60,000,000, also to be advanced by the government. When the line was first projected in 1941, its cost was estimated at $80,000,000, all of which was to be furnished by the industry.

Suggested in 1941

The line as now authorized, it was pointed out by OPC officials, is virtually identical with the project which Ickes tried unsuccessfully to promote in July, 1941, and which was turned down by both the Supply Priorities and Allocations Board and, last winter, by WPB.

The board's action to complete the line was taken after Ickes made a personal appearance before it and again reviewed the situation and emphasized the need for quick action to safeguard the East against the disastrous effects of a breakdown in presently-used transportation facilities. A considerable percentage of the railroad tank cars now in the Eastern service are in need of repairs and overhaul.

Construction of the full length of the big-inch line, completion of the trans-Florida pipe line, expansion of the capacity of the Plantation line and other pipe-line and barge improvements programmed by OPC will put the East in a far better position next year to fill the increasing demand for oil.

But it was stressed by Ickes that the big-inch will not mean lifting of restrictions on consumer use of oil and gasoline.

"The allocation of the 219,000 tons of steel necessary to continue the line to the East Coast is recognition of the fact that only by having such a pipe line can the Atlantic Seaboard be provided with a dependable additional supply of the petroleum so essential to the successful prosecution of the war," he said.

Ickes Wants Second Pipe

"The oil that this line will deliver to the refineries of the New York-Philadelphia area will benefit not only our war industries but, more important still, it will make possible the release of many ocean-going tank ships from the long water haul from Gulf Coast ports. This fact alone is justification enough for the extension of the line at this time, for it will aid us materially in carrying the war to the enemy. In fact, so important do I regard the function the pipe line can perform in the winning of this war that it is perfectly clear to me that we must not only complete this line with the utmost dispatch, but that we must immediately give consideration to the advisability of constructing still another paralleling the first.

"It is my hope and expectation, in the meantime, that the public will understand and appreciate that the line, for which steel has now been allocated, can not be counted on to provide unrestricted supplies of petroleum products for general civilian consumption. Its primary function, first, last and always, must be to insure adequate petroleum supplies for our armed forces, the United Nations, war production, and the basic needs of civilian transportation and health."

As in the case of the first leg, the second section of the line is expected to be financed by RFC through Defense Plant Corporation and work will be supervised by War Emergencies Pipeline, Inc., which is constructing and will operate the Longview-Norris City segment, Deputy Coordinator Davies said.

Work in Progress

Aerial surveys of the proposed route across the Alleghanies were completed last year, and no delays are expected in establishing the route as right of way can be secured, if necessary, under the Cole Pipeline Act, he explained. Ground parties already are in the field staking out the exact route to be followed, he disclosed, and the ground survey is expected to be completed in 60 days.

The full 1388-mile line is expected to go into operation by June 1, Davies declared. Twenty-five pumping stations will be required to force the oil from Texas to the East Coast.

The second leg of the line will run from Norris City across Indiana and Ohio to Phoenixville, Pennsylvania, from which point branches will run to the Philadelphia and New York areas. The mountains will be crossed at the narrowest possible point. The line will be constructed of either seamless or electric welded pipe, or both, for either of which there is adequate mill capacity available and between which there is little difference in quality, it was said. The leg now under construction is being built of seamless pipe.

CENTRAL AUTHORITY: Decision as to consolidation of authority over the oil industry has not yet been reached by President Roosevelt, it was disclosed at the White House during the week.

Questioned directly as to whether he had determined the desirability of eliminating the conflicts on oil arising out of division of authority, the President said the matter is still under study.

RATIONING: Proposals for deferment of nation-wide gasoline rationing, urged in resolutions adopted at the October meeting of the Petroleum Industry War Council, have been turned down by Rubber Director William M. Jeffers and Price Administrator Leon Henderson.

Jeffers, in a letter to Chairman William R. Boyd, Jr., of PIWC, admitted that the rationing program will cause difficulties, but contended it is "vitally essential that we get the program of rubber conservation under way as quickly as possible." He indicated also the need for control of persons who would not comply with a voluntary conservation program.

Henderson based his rejection of the proposal on the Baruch recommendation that gasoline rationing is the only way of saving rubber, and declared that voluntary curtailment of driving and speed would not bring about the reduction of driving to an average of 5000 miles a year, "set by the Baruch report as the maximum we can afford in view of the dire rubber shortage."

"In light of these grave and weighty statements, it appears unwise to delay action," he said. "The number of tire miles which might be wasted in the course of 90 days is astronomical. Moreover, now that the program has been fully publicized, any postponement would result in a final spree of non-essential driving which would greatly accelerate this waste."

SERVICE: All price controls were lifted from drilling and fire-fighting services by the Office of Price Administration October 28, through an amendment to the general maximum price regulation based on the finding that each individual job presents its own particular problem and no fixed price or standard of pricing can be made to apply in all cases.

[*Continued on page 48*]

All Engineering Skill Needed For Industry's War Effort

By WARREN L. BAKER, Editor

AFTER three sessions of technical papers, the fall meeting of the Mid-Continent Section of the Petroleum Division of the American Institute of Mining and Metallurgical Engineers, at Austin, Texas, November 29-31, closed with assertions that it would be necessary for the industry to use all its technical ingenuity and manpower with skill and at the same time receive sympathetic and intelligent government regulation. Otherwise, it was predicted, the industry would not be able to fulfill its responsibilities in the face of additional major adjustments forthcoming as a result of war impacts.

Already the impact of changes created by the war has thrown a heavy strain on the industry, but additional readjustments are forthcoming, declared R. J. Gonzales, Humble Oil & Refining Company economist, in an address in which he traced the trend of drilling, production and refining operations along with prices and consumption. To achieve all the wartime goals ahead of it, he said the industry must be "given a fair opportunity through intelligent regulation," instead of conflicting control views resulting from the existence of numerous government agencies set up for different purposes and therefore guided only by their own established principles.

Situation Changing

To date the"remarkable thing is not the difficulties experienced in meeting new conditions, but the achievements of the industry in adjusting to the requirements of a war economy," he said. But whereas the industry has been able to continue supplying a major portion of its peacetime markets, "even that situation is now changing, as the industry is immediately faced with a sharp decline in the consumption of motor gasoline," due to rationing of this commodity. On the other hand, the economist continued, "the industry must increase its output of residual fuel oil and expand tremendously its manufacture of such critical war products as 100-octane aviation gasoline, toluene, aviation lubricants, etc." These readjustments, he thought, would thoroughly tax the ability of the industry.

"In order that the petroleum industry may make the maximum contribution to the war effort, an intelligent administration of regulations upon it is required. At present there are many government agencies, with varying degrees of authority and control over the operation of the petroleum industry. Their policies," Gonzales declared, "are sometimes in conflict because one agency is guided by certain principles while another is attempting to perform a different task. The aim of all government regulation at present should be to promote the war effort and the regulation of different agencies should be coordinated to this end. Where there are conflicts of policy between different agencies, it must be decided which policy will result in a maximum contribution to the war. A clarification of this confusion is vital today."

"The readjustments required by war in the operations of the petroleum industry, particularly in the refining branch, would have been easier to make but for controlled crude and product prices," Gonzales stated. "In normal times, prices constitute a powerful economic force, driving industry to make changes required by demand. The increase in residual fuel oil demand and decrease in gasoline demand resulting from the war, ordinarily would have been reflected in prices, and refineries would have found it economically advisable to adjust yields. Under a system of price ceilings, however, the price of residual fuel oil is not allowed to increase, and this incentive to enlarge output of an essential product is lost."

The same conditions made it difficult, he pointed out, for the industry to adjust its transportation systems, and have resulted in an adverse influence upon the rates of discovering new reserves because venture capital has not been encouraged.

Conserve Technical Personnel

The industry's technical personnel must be used with care, declared Ray L. Dudley, publisher of THE OIL WEEKLY. So many technical men have gone into the armed services, so many have been drafted by OPC and so many are engaged in OPC committee work, that "some companies are having a difficult time in carrying out their primary business of providing oil for the war effort. Utmost care should be exercised in future drafts of technical men lest they be taken from sources where they can be ill spared and put into work where the need may not be so imperative." We are learning much through cooperative efforts made necessary by the influence of war, the speaker stated.

After asserting that the industry accepted the creation of an Office of Petroleum Coordinator as an inevitable move, but "felt in its heart that the wrong man had been chosen as coordinator," Dudley stated that after nearly a year and half of the administration of Coordinator Ickes "most oil men have reversed their opinions and are glad to acknowledge he has made a fine executive, and that the prejudices which we were afraid he carried in his mind, either did not exist, or have been carefully subordinated to the big job of winning the war. I am of the personal belief that such prejudices as Mr. Ickes might have had have been cleared up by a closer understanding of the oil business and of oil men, and I will admit too that more than one side can have its thinking clouded by prejudice."

Dudley divided the interrelationship between the petroleum industry and the war effort into three parts: (1) that affecting transportation; (2) that affecting the manufacturing branch; and (3) that affecting reserves and production.

Cooperative Operation

One of the important lessons we learned when we went to war, he stated, was "that during the past two or three decades certain laws, ostensibly for the protection of the public through stimulation of competition, actually were laws which put a premium on inefficiency. Today, it is ironical that some of the very acts which were pointed out in an indictment of the oil industry are now required of the industry by the government." He was referring to pooling and cooperative operations, which today have "approached a scale never before dreamed of."

The movement of 850,000 barrels of oil to the East Coast by tank car in one day is a "genuine testimonial to efficient cooperation," Dudley continued. "We have learned much through the cooperative efforts being made in cross-country movement of oil . . . some of which will have a permanent value." The effect of the big-inch line to the East Coast will "likely be permanent and from the lessons learned in the construction and operation of this new line we may see a semi-revolution of oil transportation."

"In a space of 18 months the industry has made advances which probably would have taken 20 years in peacetime," Dudley said, in referring to the refining branch of the industry. He declared that the country would never again have to depend upon a raw supply of rubber located 12,000 miles across a hostile sea, that specialty rubbers will be manufactured that will do a much better job than natural rubber. This will afford new markets for the oil industry and new conveniences to the public. He predicted that due to the advancements in manufacture of aviation gasoline that within "the next 10 years 100-octane gasoline will be a third grade fuel." When the war is over, he continued, toluol plants will not be allowed to rust, but "will be producing products which

will have a real place in the solvent and plastic world."

Turning to the necessity of having an adequate supply of crude oil to meet the increasing demands for petroleum products, Dudley said "something must be done to encourage additional wildcatting," and predicted that Washington would give more consideration to this problem in the immediate future. As a partial relief to the problem, he suggested that the government might advance operators an amount of money equal to the cost of drilling wells in cases where producing wildcats were completed too far from pipe lines to get quick connections. This, he said, would be "no subsidy as the government would get its money back with reasonable interest, but it would encourage wildcat drilling as it would eliminate the tying up of the operator's capital."

While on the subject of reserves, Dudley said it was to be hoped that the shortly-to-be completed OPC report on availability of oil would be conservative. Otherwise, he warned, the industry, like the aluminum business, may find itself the storm center of criticism.

"If the report shows that certain areas are capable of very great increases in production, the report will not be complete for public consumption unless the relationship between such production increase and pipe-line outlets is considered also. To fail to consider these points in the beginning, could well lay the basis for federal control from here on out."

At an evening banquet, E. DeGolyer, assistant deputy petroleum coordinator, discussed additional problems of the industry, but devoted most of his remarks to information gathered on a recent trip to Mexico. Technical papers were for the most part devoted to laboratory research studies of reservoir performance control and drilling muds. Abstracts of these papers follow:

The Influence of Gravity in Oil Recovery

By JAMES O. LEWIS, Consulting Engineer

The important natural agents for effecting oil recovery that may be originally available in a reservoir are gas, encroaching edge water and gravity. Only recently has the function and importance of gravity received its due consideration. Gravity is the only one of these important agents always present, and which can occur without the others being present, although gas is almost always present in solution.

For gravity drainage to become effective, the other forces must be immobilized. If water invades the reservoir faster than the oil can drain down dip, the water must be held back by imposing pressure against it. If expanding solution gas can propel oil upward through the sand against gravity, then its upward velocity and force must be reduced.

When reservoirs reach the stage of depletion that the gas can no longer overcome the pull of gravity, it will soon reach a condition where the oil collapses. The oil then tends to form a stable capillary system, in which it will drain out of the higher portions of the structure to lower portions. It will take much time for the oil to drain out of the higher parts of the structure to the lower in tight sands at low dip. Due to the variable natural conditions, variable pressures and gas velocities, the collapse will start in different parts at different times and proceed at different rates.

However gravity drainage is applied, it requires that a gas cap be formed and spread. Essentially, it is a method of progressively exhausting the recoverable oil downward in the reservoir, leaving the drained part to be filled either with high- or low-pressure gas. A substantial pressure is needed in the gas cap of a gravity drainage pool in order to increase recovery rates and reduce expenses. The pressure needed for these purposes can be gained either by conserving the gas by methods of maintaining original pressures or by slow reductions of pressures to achieve gravity segregation or by building up pressures after the natural pressures have been depleted.

With gravity drainage, the oil should be produced from wells low on the flank of the structure and crestal wells should not be produced except when it is desired to blow off the gas. Also, the wells with the lowest oil/gas ratios should be produced and the wells with the highest gas/oil ratios should be shut in. However, neither of these general principles need be carried to extremes.

A Reconnaisance Study of the Adams Oil Field

By L. H. ESCH, R. P. GRANT, and L. S. MILLER, Michigan Geological Survey Division, Department of Conservation

Apparently in the Adams oil field, Arenac County, Michigan, conditions of permeability and porosity were more important than structure in accumulation of petroleum. Conditions in the field lend weight to the theory that eventually oil fields will be found in the Michigan Basin in which structure plays little part, but other types of stratigraphic traps control accumulation.

The Adams anticline appears to be locally two parallel folds, approximately two miles apart and possibly connected by a saddle. The northern, higher fold has so far proved non-productive of oil, but has some small Berea gas production.

The two closely spaced parallel folds and a possible connecting saddle suggest cross folding and probably explain the trap which enclosed the oil of the field. Small isolated knobs suggest that the top of the Dundee formation is an erosional surface. The Dundee formation structure is rather broad and flat with dips of 50 feet per mile on the north flank and approximately 30 feet per mile on the south flank.

Available evidence indicates that large production may continue for a relatively long time in the Upper Dundee formation. A possible connection between this producing area and a closely adjacent oil accumulation of large proportions is indicated, or the evidence may be interpreted as showing that the field limits may be extended.

The Detroit River formation has four wells, three at the extreme southern end of the field and one at the extreme northwestern edge. The two areas of development are three miles apart. It is entirely possible that all or a portion of the territory between the two areas will produce.

All information from the Adams pool seems to indicate a nearby structure or zone of accumulation which should repay exploration. Further thorough search by geological study and drilling are fully justified by the evidence.

S. P. Dipmeter Surveys

By H. G. DOLL, Schlumberger Well Surveying Corporation

The problem of determining the angle and direction of the dip of the strata traversed by a borehole is of practical interest, and sometimes of vital importance to the oil industry. Need for that type of information has led to a number of methods for obtaining or approximating this information, a new "S. P. Dipmeter" service now being offered.

Some decade ago an electromagnetic teleclinometer and dipmeter was offered which, though requiring delicate adjustment, could give bottom-hole data. The new surveying method operates in the uncased portion of the hole, by means of three independent electrodes. Since the three points are sufficient to determine a plane, orientation of this fix, obtained by means of a photoclinometer, provides all salient data, including inclination and orientation of the hole at the point of the survey.

Operation of the dipmeter is based on the phenomenon that the spontaneous potential measured by an electrode varies in an abrupt manner when that electrode traverses the boundary plane between a porous stratum and a nonporous one. This phenomenon being recorded simultaneously but independently by each of the three electrodes of the instrument, three logs are thus recorded, substantially alike, but varying in respect to the fact that the three electrodes do not inscribe themselves at exactly the same depth. The discrepancies in depth correspond precisely to and are a measure of the dip in the boundary plane, and consequently of the beds themselves.

In practice, the dipmeter is run down the hole to a point below that of the intended survey, the recordings of the three electrodes being taken on the way down to insure functioning of the device. Then raised to just below the point of survey the instrument is halted and the photoclinometer used to check orientation and inclination of borehole, after which the instrument is pulled past the formation change and the record made, a second photoclinometer picture being taken to insure against rotation of the instrument during the recording lift.

Check of the three electrode curves by superposition, and measurement of the amount of shift required to obtain this coincidence of the curves, gives geometric data from which it is possible to compute the exact dip and its direction, correction being made, of course, for any inclination of the hole as shown by the photoclinometer.

Summarized, dipmeter measurements permit the oil industry to obtain reliable information about the dip of formations in all types of geological structures favorable to the accumulation of oil, including anticlines and domes to monoclines, faults and unconformities.

Relationship Between Velocity, Oil Saturation and Flooding Efficiency

By R. C. EARLOUGHER, Geologic Standards Company

Since interstitial water is such an important factor in water-flooding operations, it follows that any laboratory flooding experiment must necessarily take it into account. Since it is difficult to set up laboratory models to allow for interstitial water, the next best procedure is to use fresh core samples for

[*Continued on page 44*]

Advances in Oil Prices Needed To Avert Threatened Shortage

By M. G. CHENEY
Petroleum Geologist and President of Anzac Oil Corporation, Coleman, Texas

PRESENT price restraints imposed on the oil industry, regardless of the worthiness of the objective, seem to constitute neither good economics nor a safe national policy. Oil prices when pegged were still close to depression levels. Adequate new supply cannot be developed under present conditions, and the eventual scarcity will no doubt cause excessively high prices in the end, as shown by the shortage-induced sharp rise in crude prices during and after World War I. It appears that the consumer would be much better off to pay somewhat higher prices now rather than risk facing excessive advances under a condition of great scarcity. An increase in price would give reasonable assurance of an adequate supply.

Discovery costs have advanced over 300 percent during the last few years. Since 1939, discoveries have been holding up in number but appear to be far less prolific than in the past. Regardless of further improvement in finding methods, diminishing returns may result from future efforts. It seems that huntsmen now-a-days must be reconciled to smaller game.

Stripper wells, which account for 16 percent of current production and 20 percent of known reserves, are being prematurely abandoned because of adverse economic conditions. Nearly 2200 small oil wells have been plugged in Texas during the first 9 months of 1942, compared with only 1534 in the full year of 1940. This constitutes physical waste, and is being increased because of necessity of producing better wells at excessive rates to meet war demands. It is probable that only a few oil fields of Texas, the only state with a sizeable surplus of current producing ability, will support much higher rate of output than at present.

After paying for drilling, equipment, royalty, lease operation, overhead and other charges, there remains no margin of income with which to explore for new reserves, especially in the case of small producing units which commonly do about two-thirds of the wildcat drilling.

It will take the combined effort of all oil producers to maintain a discovery rate equal to withdrawals. No one can safely predict how much petroleum will be needed to win the war. The only sound procedure is to see that the producing industry has sufficient income to maintain present producing wells and carry on extensive wildcat operations.

The accompanying article was presented before the Texas Statistical Council at Austin, Texas, on October 23, 1942.

PETROLEUM has given tremendous speed and striking power to this second world war. The fighting equipment of the United Nations, costing hundreds of billions of dollars, is practically useless without oil and its products. The oil industry is alert to the responsibility which arises from dependence of our war machine on ample supplies of highest quality petroleum products. The best trained men and finest equipment will prove unavailing in present-day mechanized warfare if fuel and lubricants are deficient. Petroleum required is now four times greater in quantity than in World War I—and our war industry and war machine are only getting well started. The oil industry must not only meet huge volume demands without fail but it is being called upon for many special products of a most essential nature, such as 100-octane gasoline, lubricating oils adapted to extreme temperature fluctuations, and more recently butadiene for rubber, toluene for explosives, and numerous other products. Quality, developed through intensive research work, becomes more critical now that the Axis has acquired near equality in natural resources. Our American oil industry takes on even greater importance as strategically located oil fields and refineries of our allies are destroyed, captured, or subjected to attack by the enemy.

Most appropriately, our federal government created the Office of Petroleum Coordinator about the time our Lend-Lease law was passed. The coordinator has secured a most eminent staff of technical experts and set up a large Petroleum Industry War Council thoroughly acquainted with all phases of the oil industry. Those in the industry feel that if this industry fails in its part in the war the blame will rest elsewhere than on the coordinator, his staff, or this committee. It is recognized that even Herculean efforts can be choked by shortages of skilled labor, critical materials, transportation facilities, or of operating income available after meeting rising costs of discovery, development and production. It is obvious that the marketing end of the business will be depressed under nation-wide gasoline rationing; that the refining branch of the industry has been stripped of profit by higher transportation costs and 25 percent smaller yield of its main income product, gasoline, to provide more heating and industrial fuel oils. Price ceilings have stood in the way of adequate compensation for these enforced changes. The industry's pipe-line facilities must operate on 8 percent or less return—about half of which is now absorbed by income taxes. There remains the oil-producing branch which must find and produce the oil under ceiling prices, now 40 percent below 1926 figures.

At the beginning of World War II, spokesmen for the petroleum industry expressed confidence that all essential needs for petroleum products required by the United Nations could be easily met from known excess reserves. This was doubtless true for the time being but after 10 months of war experience, there is less and less confidence if present trends are projected a year or more ahead. Doubtless few expected the Japs to capture the oil fields from Burma to Java, nor were difficulties at home fully anticipated. Various factors have caused a national decline of 50 percent in rate of drilling and 61 percent in number of producing wells completed. Such was the case in July, 1942, as compared with July, 1941. Texas drilling is down 69 percent and new production off 75 percent.

Abandoning Small Wells

War needs threaten to attain new high records of consumption in spite of rationing. Furthermore, many oil companies predict that due to shortage of materials and labor and reduced margin of income over and above present costs, that drilling must be further curtailed during the coming year. As a further index of present adverse conditions,

Railroad Commission records show that in Texas alone nearly 2200 small oil wells have been plugged during the first nine months of 1942. This should be compared with 1534 small oil wells plugged for the full year of 1940 when conditions were more normal. At least 100,000 such small oil wells are in jeopardy. Stripper production is said to be 16 percent of current production and 20 percent of present reserves. Present adverse economic conditions in the oil industry must be held responsible for the physical waste which will result from premature abandonment of these many small wells and the even greater physical waste which is likely to result from necessity of producing many of our oil fields at excessive rates in order to meet war demands.

Committees organized by the Office of Petroleum Coordinator have nearly completed a reappraisal both of known recoverable reserves and possible additions by extensions of present fields. A particularly important phase of this investigation is the determination of the maximum efficient rates of production for the various fields. The committees report wholehearted support by the oil industry in these important basic studies which under war conditions may be expected to remain confidential, especially as to details.

Largely as a result of wise conservation policy and extensive wildcatting for the past 20 years, the recoverable known oil reserves of Texas are now generally estimated as between 11 and 12 billion barrels, 56 percent of the total for the United States. The current output for this state of 500 million barrels yearly is about 34 percent of the nation's total.

Few Fields Underproduced

It is probable that only a few oil fields of Texas will support much higher rate of output than at present. Probably three-fourths of our reserves are in reservoirs from which oil is expelled mainly by a water drive. Production much in excess of the rate at which water moves into the reservoir brings on excessive production costs and causes much physical waste due to trapping of oil in the less permeable parts of the reservoir. Efficient rate of flow from the remaining fields which are fields dependent primarily on gas drive is determined mainly by the rate of flow at which best gas/oil ratios are obtained and in part by the rate at which engineering considerations permit return of gas to the reservoir. Railroad Commission reports show about 500 billion cubic feet of gas is being returned annually to underground reservoirs in Texas. Less than 6 percent of the total gas produced in Texas is being vented to the air, this being largely unavoidable waste from oil wells, many of which are in areas remote from gas markets. In many cases, this gas has accomplished important work, a few hundred or at most a few thousand cubic feet of gas with value at the well of 2 to 6 cents per thousand having lifted to the surface a barrel of liquid weighing 300 pounds a distance of as much as 10,000 feet. In most fields gas must be produced with the oil and the greater demand for oil comes during summer months when gas is least needed. Much of the vented gas contains sulphur, the removal of which costs several cents per thousand. Greater conservation measures seem to be an economic question. Prevailing prices for gas and natural gas gasoline (selling during recent summer periods at 2 cents per gallon) do not stimulate maximum conservation efforts.

Overall oil production in Texas remains at a high level but widely variable as to fields and districts. Disruption of out-of-state tanker shipments has forced extreme curtailment of production from many Southwest and West Texas fields. Greatly increased demand for high-octane gasoline, butadiene and toluene have favored the use of naphthenic oils, although it appears that these products can b produced satisfactorily from paraffinic oils under high temperature catalytic cracking (Houdry process). Type of refinery equipment and market outlet available to the particular company determines its crude-oil needs. Certain districts are wholly dependent upon the needs of individual crude-purchasing companies. The amount of reserves and readily available oil varies widely among the various larger companies. Thus many factors are responsible for present spotty conditions in the oil industry of this state.

As recently pointed out by DeGolyer (July, 1942 Bulletin, A. A. P. G.), oil discoveries during the periods 1926-1931 and 1934 to 1938 were unusually large. Unproduced reserves increased 9 billion and 4 billion barrels respectively during these two periods. According to a survey of Petroleum and Natural Gas Production completed in 1939 as a National Research Project of the W. P. A. and Department of the Interior, Bureau of Mines, the discoveries during the first of these periods came from geological, geophysical work and a random drilling to the extent of 5.8 billion, .8 billion, and about 4.5 billion barrels respectively, most of the random drilling discoveries being represented by the huge East Texas field located in known favorable territory. During the second period the score was 2 billion, 3 billion, and .06 billion barrels respectively. It is of interest to note that the most successful geophysical method developed during this latter period, the reflection seismograph, came into prominence about 1930, using principles proposed in 1920 by Dr. J. A. Udden, then Director of Bureau of Economic Geology and Technology, University of Texas.

Regardless of further perfection of discovery and drilling methods, which have made such remarkable progress since 1926, there is no assurance that discoveries in the United States will again equal or even approach the 26 billion barrels record for the 1926-1938 period, an average of 2 billion barrels per year. Coincidental occurrence of the several requisite geological factors in such favorable circumstances as were present in extensive fields of the Seminole, Oklahoma City, West Texas, East Texas and Gulf Coast areas are not commonly found. The East Texas field alone will have ultimate recovery equal to more than 200 major oil fields using Pratt's* minimum figure of 20 million barrels as qualification for a major field.

Future Fields Smaller

Since 1939 discoveries have been holding up in number but appear to be far less prolific than during the lush period ending in 1938. It may prove true that intensive search for petroleum aided by advancing technical methods during the past 30 years has exhausted a large portion of the more favorable hunting ground for oil fields in this country. Regardless of further improvement in finding methods, diminishing returns may result from future efforts. One is reminded that improvements in firearms did not maintain successful buffalo hunting. It seems that hunfsmen now-a-days must be reconciled to smaller game. At recent Senate subcommittee hearings our price administrator expressed the opinion that the oil industry must be "poverty stricken" as to scientific help in its efforts to discover oil. Needless to say, most of those acquainted with the actual difficulties involved in discovering 1.5 to 2 billion barrels annually were left aghast by this apparent utter lack of understanding on the part of one who holds life and death control over this industry. The records from 1937 to 1941 show that 1 out of every 6 exploratory (wildcat) wells drilled on technical advice was successful. This compares with 1 producer out of 20 wells drilled for non-technical reasons, these figures being from recent reports on wildcat drilling by Lahee (June 1942 Bulletin, A. A. P. G.). Wildcatting during 1941 attained the very favorable record of 1 producer out of 4 wildcat wells drilled on geophysical data, 1 out of 5 based on geophysical and geology, and 1 out of 5.6 based on geology alone. These results compare with 1 out of 26.7 based on sundry non-technical reasons during that year.

It seems to be unsound economics to

* Oil in the Earth by Wallace E. Pratt, University of Kansas Press, 1942.

judge the oil industry at large by the notable successes of a few of its members. If we are interested in securing all the oil that is needed, we must be guided, not by the success and favorable income statements of the few most fortunate operators. The discovery of oil is usually a matter of intensive effort over a period of years. Current prices should take into account probable future, not past, costs of finding new reserves of at least 1.5 billion barrels annually. In changing from past conditions of temporary over-supply to a situation in which supply appears uncertain, prices must be adjusted to cover at least average costs, advancing further to cover the higher cost increments needed to meet total demand in event scarcity actually develops.

Discovery Costs Higher

It has been estimated by Pratt that discovery costs have advanced over 300 percent during the last few years. At present, about one-fourth of the producer's income must go for royalties and taxes and nearly half of the remainder for lease operation and overhead costs. After paying for drilling and equipment costs and interest charges for several years on these capital outlays, there commonly remains no margin of income with which to explore for new reserves, especially the income of the many smaller producing units which commonly do about two thirds of the wildcat drilling. Every oil producer knows that his future depends upon replacing the oil reserves which he is constantly depleting. It will very likely take the combined effort of all oil producers to maintain a discovery rate equal to withdrawals, which normally increase about 7 percent annually. No one can safely predict how great the need will be to win the present war. The only sound method to secure this united effort toward new discoveries is to see that the oil producing industry has sufficient income to maintain present producing wells and carry on extensive wildcat operations. Reduced complexity of regulations and volume of reports required and a minimum of contradictory attitudes by the various governmental departments would be of material aid to the industry.

Need Higher Prices

Present price restraints imposed on the oil industry, regardless of the worthiness of the objective, seem to constitute neither good economics nor a safe national policy. Adequate new supply cannot be developed under present conditions, and the eventual scarcity will no doubt cause excessively high prices in the end. During and following the previous war, oil prices advanced 500 percent over a 5-year period. It appears that the consumer would be much better off to pay somewhat higher prices now rather than risk facing excessive advances under a condition of great scarcity.

The question of inflationary prices does not seem to be involved since crude-oil prices and petroleum products now stand 40 percent below their normal relationship with other commodities based on Bureau of Labor statistics. Oil prices when pegged were still close to depression levels which came as a combined effect of the general economic depression and the industry's ability for a time to find too much oil. Increase of crude and product prices to near parity levels would merely serve to bring reasonable return on the industry's 15 billion dollar investment. An advance averaging around 1 to 2 cents per gallon in crude and product prices would scarcely be felt in total operating costs of industry and the war machine. Such an increase would give reasonable assurance of an adequate supply of this essential "ammunition." The present policy of risking so much to gain so little appears "pennywise, pounds foolish" in the extreme.

The record in Texas seems to be getting steadily worse as indicated by Railroad Commission weekly report of October 10 which showed completion of 22 dry holes as against 4 oil wells and 2 gas wells. Recently the petroleum industry was given higher priority ratings on its essential materials. Completion of the 24-inch pipe line from East Texas to Illinois will increase outlet for Texas oil by an estimated 100,000 barrels per day. These somewhat more favorable factors are offset by increasing losses of highly trained personnel, already exceeding 50 percent in some areas. By and large, present trends in the oil industry throughout the country are such as to warrant immediate national concern.

MAINTENANCE HINT

Tape and Shellac Protects Welding Cables

RUBBER covered cables, used in the field on portable drilling rigs, unitized equipment, etc., are among the materials which probably will not be readily replaced.

Steps have been worked out to make every one of these cables now in use last just as long as possible. The cables are wrapped with a good grade of electrician's friction tape, then coated with shellac. Admittedly expensive, both in time and materials consumed, the company using this idea nevertheless believes it will be definitely advantageous to protect present cables rather than cope with the inevitable troubles expected to accompany the use of ordinary cotton-and-asphalt-covered cables later on.

In addition to protecting the rubber cable from deterioration in the sun, the tape-shellac covering prevents much injury sustained by nicking or cutting on rough corners of equipment, as well as shielding it from splashes of oil or gasoline.

Clogged Gas Lines Cleared With Portable Steamer Units

By F. O. CRAWFORD
Operating Superintendent, Gas and Water Department,
Illinois-Iowa Power Company

STEAMING out of oil lines to remove paraffin deposits and other wax-like accumulations has been used successfully on both lease and trunk oil lines, but it remained for the Illinois-Iowa Power Company to adapt this procedure to the clearing of gas lines.

A 4-inch line of this company, used 14 years to transport carbureted water gas 22 miles from the Centralia, Illinois, gas plant to the distribution mains of Mt. Vernon, Illinois, was known to be restricting flow, but as compressors were used and a pressure of 100 pounds per square inch could be maintained at the gas plant, the required volume was delivered at the end of the line.

When the system was changed over from carbureted water gas to natural gas in November, 1941, with field pressures ranging only up to a high of 35 pounds, the situation became acute.

The problem was immediately posed of how to remove the accumulation of coal tar which had been compressed and sent along the line to separate from and drop out of the light oils during the time of transmission through the line. This accumulation was so serious as to demand instant action if the deliveries were to meet Mt. Vernon requirements. By January, 1942, only three months after the change-over in type of gas transmitted, it was impossible to handle the minimum requirements through 38,000 feet of line. Arrangements were completed for an auxiliary supply, and plans made to attempt to steam out the accumulated tar residue from the line.

Portable flash boilers* were secured, two units being employed to expedite the work. The clogged line was dug up at 1000-foot intervals and then, due to extreme cold weather and excessive deposits, this interval cut to 500 feet between cuts. Steam was fed into each of these cut sections, in the direction of normal gas flow, under an available maximum initial pressure of 300 pounds per square inch and the blow maintained until the section showed no further flow of tarry residue from the open end.

Cut sections were reunited with cou-

Truck-mounted steamer unit, carrying its own supply of fuel oil and water for the flash-type steam generator, and capable of 4-hour runs without refilling, provided ample steam capacity for clearing even the most stubborn sections without shut-down or break in steam flow.

Four-inch gas main, at one of the sections, showing type of tar accretion, and practically complete closure of passageway. Only pores through this material permitted passage of small quantity of gas under compressor pressure of 100 pounds per square inch.

Thick, viscous fluid adhering to pipe walls and flowing from open end of line after sectioning. Taken in August, this material shows slight fluidity, but during winter weather acted solely as choke and lining within the line unless extraneously heated.

One of the cuts made in the line to permit introduction of steam for melting and driving out tar deposits, the line being capped behind cut and by-pass tied in to permit continuation of service during period of line work-over with steam units.

With application of steam the tar deposits become liquefied and as the pipe heats up the flow begins at the free end. This stream of tar and hot water brought as high as 1600 pounds of deposit from some of the 1000-foot sections into which the line was divided for ease of servicing.

plings or the abutting ends welded after completion of the steaming process.

In August, 1942, the cleaning of the line was completed, adding 41,000 feet to the 38,000 opened in January. Since there could be no suspension of service during the steaming operation, a by-pass method was worked out which would permit the line—with the exception of the segment undergoing steaming—to carry gas. The by-pass consisted of two separate sections of 2-inch pipe, each made up to span 3000 feet. By tying in one around the section to be cleaned, it could transport gas effectively while the second section was being moved ahead and readied for in turn serving to replace a portion of the 4-inch.

Since the main was cut into 1000-foot sections for steaming, it was possible to make three blows before again tying in the sectional by-pass. Under this method, and with the added advantages conferred by summer weather, it was possible to service 9000 feet of line per day.

At the cuts where the by-pass was connected in, the tie-in consisted of a coupling or sleeve, carrying in its end a fitting into which was connected an ell of the by-pass, a valve permitting regulation of the flow through the 2-inch, and a short run containing a stub and valve for venting. The steam line, connected into the other end of the 4-inch, was carried through a swivel joint into offset connections to afford proper alignment with the line, a pressure gauge being installed at the tie-in to permit accurate check of pressures being imposed on the line.

At places along the section of line steamed out in August accretions which completely filled the cross-sectional area of the pipe were found, any gas travel occurring having been solely through pores within the tarry mass. From some sections as much as 1600 pounds of tar was removed from 1000 feet of pipe.

Steaming of the line over the period required to melt and force from the cut section the accumulated tarry residues was found to heat it enough to cause marked expansion at the free end, this elongation amounting in some instances to as much as 5½ inches. Provision for shrinkage to former dimensions had to be included in any method of joining the cut sections.

Cost of steaming out the line in August was less than half that of the winter operation, the comparative figures being .70 cents per foot in January and only .315 cents in August.

Due to features built into the steaming units, it was possible to blow live steam alone, or any desired combination of steam as produced in the flash unit with water later introduced into the flow, thus permitting close regulation of the amount of heat being imposed on the line, together with provision of a high-temperature flushing medium which would aid in carrying the softened or molten accretions through the open end of the cut section. Line steamed out was inspected visually at the cut sections, and was found to be free of deposits, with the pipe wall practically as smooth as when originally delivered from the steel mills.

*Truck Mounted Steam Cleaning Unit Performs Many Jobs, The OIL WEEKLY, August 17, 1942, Vol. 106, No. 11, pages 17 et seq.

Mobile equipment was used for cleaning and servicing the line. A welding truck, with both acetylene and arc equipment, made the cuts and provided means of welding line junctions where sleeve types of couplings were not employed.

Principles of Corrosion and Cathodic Protection

By NORMAN CLARK

CORROSION is the electro-chemical disintegration of metallic substances caused by a flow of electricity between zones of differential electric potential. Any metallic system may have differing electric potentials for a varied number of reasons. The more important factors will be discussed herein.

It is evident that many of the metals used today are never found free in their native state. The reason for this is theoretically explained by the electro-chemical theory of oxidation and reduction, and empirically supported by chemical tests.

When two dissimilar metals are placed in an electrolyte and connected by a conductor, the two metals assume different electric potentials, and there will be a flow of current from the metal of higher or more positive potential through the solution to the metal of lower or negative potential. A galvanic cell is the result. The electro-positive metal will, upon current flow, become corroded, the corrosion products depending upon the type of electrolyte present, while the electro-negative metal will be protected.

The electro-chemical series of metals is formed by placing the metals in their respective potential order and is given as follows:

Electro-Chemical Series

METAL	Symbol	Potential (Volts)
1. Potassium	K	+2.92
2. Sodium	Na	+2.71
3. Calcium	Ca	+2.50
4. Magnesium	Mg	+1.86
5. Aluminum	Al	+1.34
6. Manganese	Mn	+1.00
7. Zinc	Zn	+ .76
8. Iron	Fe	+ .43
9. Cadmium	Cd	+ .40
10. Cobalt	Co	+ .29
11. Nickel	Ni	+. 22
12. Tin	Sn	+ .13
13. Lead	Pb	+ .12
14. Hydrogen	H	0.00
15. Copper	Cu	— .34
16. Mercury	Hg	— .80
17. Silver	Ag	— .80
18. Gold	Au	—1.50

Any metal appearing above another metal in the series will, to a certain degree, protect the lower more negative metal. The degree of protection depends upon several things, principally the difference of potential.

When a metal is immersed in a metallic salt solution, with the metal of the salt having a more negative potential, the metal immersed will displace the metal in the solution. A good example is the reaction that takes place when zinc is immersed in a copper sulfate solution.

Zinc + Copper Sulfate — Copper + Zinc sulfate

$Zn + Cu\ SO_4 \quad — \quad Cu + Zn\ SO_4$

If a porous cup, filled with a weak electrolyte, is placed in a container of strong electrolyte, such that the two solutions will not mix, and joined by a conductor, an electric current will pass from the weak solution to the strong one by way of the conductor. This current will then be discharged at the surface of the conductor in the electrolyte of higher salt concentration because of its lesser resistivity. The conductor will suffer electro-chemical disintegration at the point of discharge into the stronger electrolyte, while it remains protected from such at the contact in the weaker solution. The degree of protection and the type of corrosion formed at the two contacts will vary for different concentrations and types of electrolytes. It is well to note that current moves in the direction of the least resistance, which occurs in the stronger electrolyte.

Electrolysis

The fourth and probably least important phenomenon in relation to corrosion is the phenomenon of electrolysis. Electrolysis is the decomposition of a chemical compound by an applied direct electric current. A simple example is the electrolysis of water. If two terminals of a source of direct current are immersed in water there will be an immediate decomposition of the water affected by the applied current. Oxygen will be liberated around the positive lead. Because the oxygen ions, which are negatively charged, give up

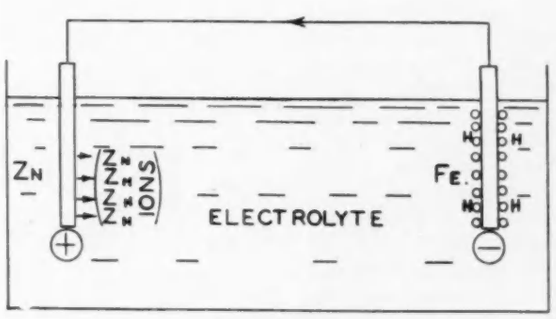

FIGURE 1

Galvanic cell formed by zinc and iron immersed in an electrolyte and connected by a conductor. Note current discharge from zinc with particles of zinc being carried into solution and hydrogen gas polarizing the iron.

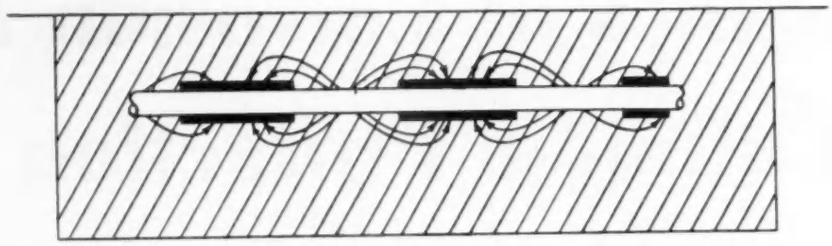

FIGURE 2
Section of pipe line, showing galvanic cells formed by the line and rust on the line.

their excess electrons, becoming free oxygen and passing off as gas, this liberation occurs at the positive lead. At the negative lead, hydrogen ions, which are positively charged, are forced to take on electrons, thereby neutralizing the excess positive charge, becoming free hydrogen and passing off as a gas.

If a clean piece of iron is immersed in pure water, there is an immediate reaction. Because iron is electro-positive to hydrogen in the water, it displaces hydrogen at the contact with water. The reaction is slow and diminishes slowly as the contact surface is covered with free hydrogen. When the surface is completely covered by the free hydrogen film, the displacing reaction is halted. Corrosion is not in progress at this point since the hydrogen film acts as a protective coating against added corrosion. For further reaction the hydrogen must be taken away from its insulating position. Removal can take place in two ways: it may react with dissolved oxygen in the water to form more water, or it may pass off as bubbles of free hydrogen gas. Since the reaction is too slow to generate bubbles of hydrogen, the former will account for the greater part of the film's removal from the contact surface. The greater the oxygen dissolution in water, the greater also will be the rate of the iron's leaving the free state and going into solution, which is caused by the excess oxygen's uniting with hydrogen and carrying it away from its point of liberation. Provided there is oxygen in the water, the corrosion product will be insoluble hydrous ferric oxide, a form of ferric hydroxide, which precipitates as it is formed and remains encrusted on the iron surface in contact with water. The rate of rusting will diminish as the rust scale thickens since the position of the rust scale between the iron and water proves resistant to reactions.

Acidity Increases Corrosion

Corrosion will greatly increase as the acidity of the electrolyte increases until, in strong acid solutions, the hydrogen is displaced so rapidly that it bursts forth as bubbles of gas. Solutions of primary alkalinity are non-corrosive while solutions of less alkalinity are slightly corrosive. In other than extraordinary cases, ground waters of the land are more nearly neutral. The pH values, or hydrogen ion concentration of an exactly neutral solution is 7. Ground waters with tests showing pH values less than 7 will be more corrosive due to their acidity, while those with tests showing higher pH values will be less corrosive due to alkalinity. For example, a saturated solution of ferrous hydroxide, a soluble product of iron, will have a pH value of 9 and will hinder corrosion. This product of iron is formed only under certain conditions.

Different Electric Potentials

It has been pointed out that when two dissimilar metals are connected by a conductor and immersed in an electrolyte, the metals assume different electric potentials and a current discharges from the more positive metal into the electrolyte. Particles of the metal are carried into solution as corrosion at the point of discharge. Insoluble ferric hydroxide plated out as rust on the surface of iron will form a second plate to iron, and when the two are immersed in an electrolyte, a galvanic cell is formed. Iron is positive to rust and will be broken down through the current flow in the galvanic circuit. Current flows from the pipe into the conductive ground water. As it does so, it leaves products of corrosion at the point of discharge. Free iron, therefore, loses electrons and becomes positively charged iron ions. When the iron ions contact negatively charged hydroxyl and oxygen ions, they combine to form electrically neutral hydrous iron oxide molecules that precipitate at the point of current discharge—the positive or anodic area. Positively-charged hydrogen ions, formed from the dissociation of water, are attracted to the cathode, the negative pole of the galvanic cell, where they take on electrons from the circuit to become free hydrogen gas. The liberation and gathering of hydrogen at the cathodic area causes an increased resistance to current flow in the cell. This resistance is due to a counter electromotive force between the hydrogen on the cathode and the corrosion product on the anode. Current will tend to become static between the original poles of this cell when the counter electromotive force of the two materials plated out reach the same value as the

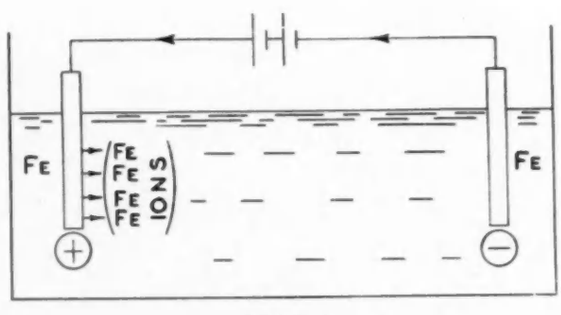

FIGURE 3
Electrolytic cell, showing metallic disintegration of the anode.

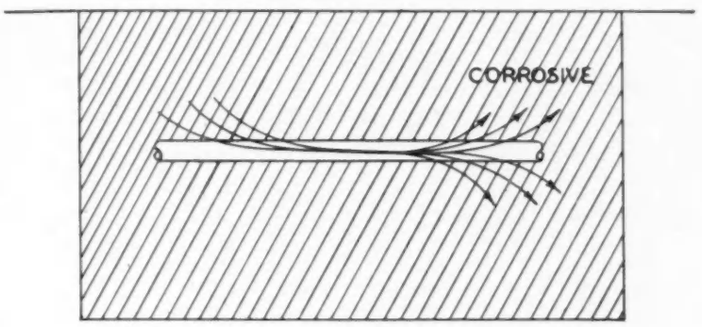

FIGURE 4
Section of pipe line, showing effect of electrolysis.

original electromotive force of the two dissimilar metals. This effect, the effect of polarization, tends to limit the corrosion of all exposed metallic material.

Mill Scale

Mill scale that is left on steel at the mills is negative to steel and, in effect, will set up a galvanic cell with steel when placed in an electrolyte. Corrosion begins immediately on the iron surface when the material is put into service and comes in contact with moisture. The action is caused by the galvanic cell formed between mill scale and iron. Although it is obvious that the presence of mill scale enhances corrosion, in its final analysis, mill scale will be the factor to account for a lesser amount of corrosion than is suffered from the clean steel. Before polarization occurs, in the case of the clean steel, rust must be formed by the displacement of hydrogen. Polarization is the outcome of current flowing in the cell formed from this rust product and the steel, and will exist then only when oxygen is not present in sufficient quantities to absorb the hydrogen film.

The amount of oxygen present, dissolved in the electrolyte, will be the greatest factor in limiting or enhancing corrosion of all metallic equipment.

Ground Waters

Long lines are exposed to a great variety of soils of varying degrees of water saturation, according to the climate and terrain. As a rule, only a few inches of top soil are dry. The moisture content of top soils increases with depth to the ground water table. For their resistivities, the ground waters depend upon the amount and type of salts that are present in solution. As ground waters vary in different sections of the country, so will the resistivities of the ground waters vary in different sections. The variation may be very abrupt or by degrees. Where the changes in resistivity are more abrupt, the factors causing corrosion will be much greater as the galvanic cell is smaller in size with less internal resistivity. The rate of current flow and discharge into the electrolyte determines the amount of corrosion formed, and the current flow in the circuit will be governed by the internal resistance of the cell. Thus, the shorter the circuit the greater will be the corrosion factor.

Ferrous materials, exposed in areas near large sources of direct current, such as electric railways, will be affected by electrolysis. The phenomenon of electrolysis is probably the least important of the corrosion principles since there are few instances, other than in or near cities, where the proximity of the sources of current is sufficient to impose harmful effects on equipment. The type of electrolysis found in the industry is not exactly like that shown by the simple decomposition of water into hydrogen and oxygen. Electricity follows the lines of least resistance and takes advantage of any low resistant conductor in its course. Current that strays from large outside sources may be picked up on the surface of a nearby pipe line. The iron, having a lower resistance than the ground, allows the current to continue down the line and become discharged in zones of low resistive ground waters. At the point of discharge the pipe will be positive to the ground in electric potential, there being no discharge at points where the pipe is negative. At the point of discharge, products of corrosion are left, as in all cases of current discharging from reactive metals into electrolytes.

Short- and Long-Line Currents

Corrosion currents are divided into two groups — short-line currents and long-line currents. Short-line currents are those, as the name implies, having a very short distance between the cathode and the anode. These occur in the very beginning of corrosion between the elements that come in direct contact on the surfaces; where corrosion products set up galvanic currents to the iron between minute electric poles; where there is a sudden change of salt concentration allowing current flow to be very short along the line; and where there is any contact of dissimilar metals.

When dissimilar metal is used for certain fittings because of its noncorrosiveness, local galvanic currents will be evolved to the disastrous expense of the other metal in contact with it.

Long-line currents are currents that flow for some distance on pipe lines, before being discharged. They are the resultant of a number of short-line cells causing a continuous generation of current. Because the pipe is negative to the ground at the point of generation, the current can not leave the pipe. Flowing in the direction of lower potential on the line, the currents find a point of discharge remote from the point of generation.

Since the extensive industrial develop-

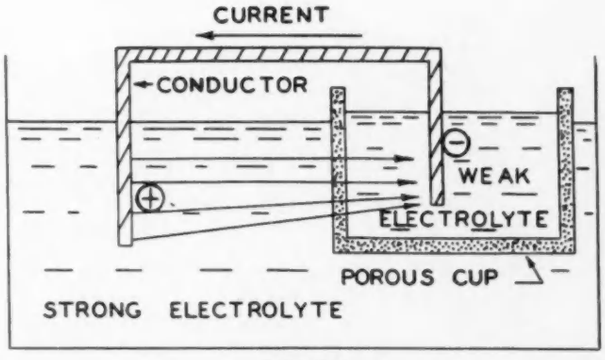

FIGURE 5
Simple wet cell, showing flow of electric current on conductor caused by two dissimilar electrolytes.

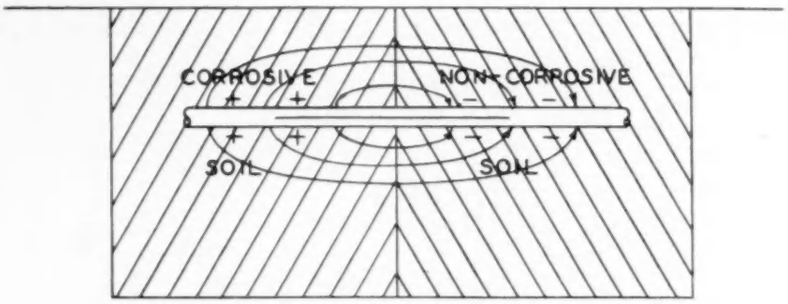

FIGURE 6
Section of pipe line in two soils, showing application of the simple wet cell with dissimilar electrolytes. Corrosion occurs at point of current discharge.

ment in America, the electrical characteristics of the land near cities have changed considerably. In their original form, the soils were more uniform in their electric potentials. Electric power has become universal and widespread, and the country has had stray currents intermittently imposed upon it. Lands have been drained, and along with cultivation, these have altered the concentration and types of salts in ground waters. In general the modernization of civilization to the industrial age has left the country in a state that is more favorable to corrosion.

Pipe lines of the early days of industry have been found to last considerable length of time longer than pipe lines of today. Many an old "pipeliner" has stood firm in his convictions that modern steel lines are inferior to the earlier types of pipe lines. Early pipe lines laid in the early days under early conditions are found superior by virtue of longer life than modern ones laid at the present time under present conditions.

When a new line is connected to an old rusty line, the ferric hydroxide coating on the old line will be negative to the metal of the new line. A galvanic cell is the result, and the new line is subject to severe corrosion, while the rusty line becomes polarized and protected from further corrosion. This fact is responsible for many biased ideas concerning the qualities of pipe.

Pipe of the earlier days was considerably thicker, a factor in favor of longer life from corrosion. Steel has developed simultaneously with the development of the industry. Strength and mechanical durability of modern steel has decreased the necessary thickness for certain pipes, thereby decreasing the length of life of the pipe on account of corrosion.

Iron and Steel

There has been much debate concerning the comparative qualities of cast iron, wrought iron, and steel. It is indeed a debatable subject, for under varied conditions the three types of ferrous metals will have a wide range of significant differences. Varied conditions of exposure will cause a formation of different products of corrosion—some beneficial and some harmful. In one area, perhaps, wrought iron will be much superior to steel, while in another area under other conditions, the steel will be superior. Taking bare metals as subjects for comparison, the corrosion rate averages nearly the same in all conditions. As corrosion products are formed and enter into the scheme of corrosion rate, there is a marked change in comparisons, usually in favor of the wrought iron and cast iron. For instance, a black, spongy material that forms on cast iron and is sometimes called graphite, is less subject to corrosion than cast iron and has sufficient strength, at times, to prevent failure after the most severe corrosion. It has been observed experimentally that an increase of phosphorous content in low-carbon steel increased the corrosion resistance of the metal. All these factors must be considered in the comparisons of the ferrous metals.

Corrosion Secondary

At the present state of pipe development, the problems of corrosion should take the position of secondary importance. For certain types of work, certain metals must be used from the standpoint of mechanical qualities and cost, and certainly, with the advent of inexpensive cathodic protection, bad corrosive qualities of certain ferrous materials may be considered secondary.

Cathodic protection is the protection given to metallic equipment to hinder or halt corrosion by means of an adjust-

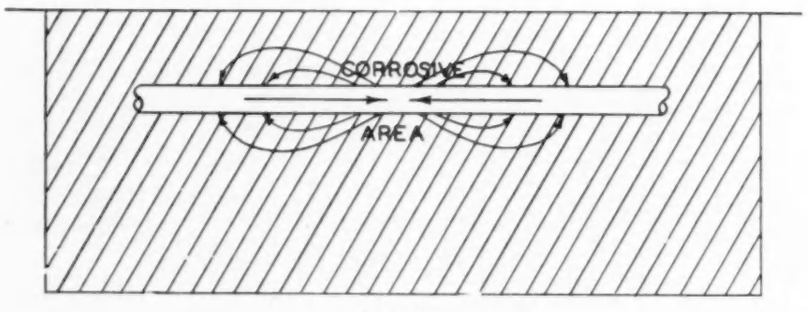

FIGURE 7
Section of pipe line, showing converging line currents leaving the line and causing corrosion.

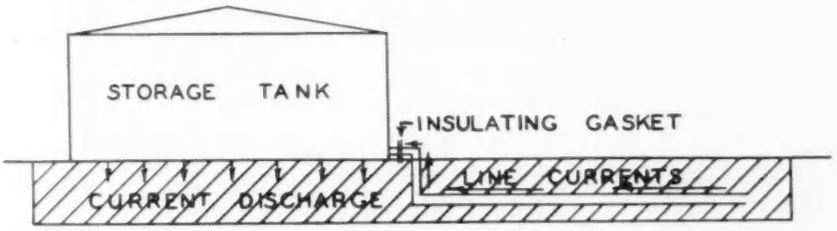

FIGURE 8
Oil-field storage tank, showing pipe-line currents flowing onto tank and being discharged from tank bottom.

ment of electric potentials by a counter electromotive force.

From the electro-chemical theory of disintegration, a metal will corrode when current is allowed to discharge from it. If by some means the metal is forced to become negative or cathodic to its surrounding area, corrosion stops, and protection by polarization is given to the metal.

In the last decade there has been such a great demand for protection from destructive corrosion of pipe lines that several methods have been devised for the purpose. Direct current applied correctly is the essential of all the methods. The current may be supplied by rectifiers, motor-driven generators, engine-driven generators, or wind-driven generators.

A suitable point for the discharge of the current must be established. A ground bed must be formed at that point consisting of a large mass of scrap iron or junk pipe. The ground bed must have ample surface for effective current discharge; it must be placed beneath the ground water table where resistance is usually minimum; it must be far enough from the pipe line to protect an appreciably large amount of line; and it must be near enough to the line to allow efficient operation of the generator or rectifier.

Other than initial cost, the copper oxide plate rectifier is credited with being the most economical for a desired current supply. Where D.C. current is not obtainable, one of the generator types of D.C. current must be used, the most economical being the wind generator type. In areas of intermittent winds, where wind stops for a considerable length of time, generators driven by wind do not prove satisfactory. A line can become depolarized completely after a few days, and, if the wind stops for some time, corrosion will start. In localities where intermittent wind stops for a very short time, the results will not be so bad as it would seem. However, to offset depolarization resulting from insufficient wind, batteries may be connected into the system to supply a continuous current, even after the generator has stopped. In areas of constant prevailing winds, the wind generator is ideal as it may be installed anywhere at nearly the same cost, thus allowing installation in localities where it is needed mostly.

The electric motor-generator type of current may be obtained, but its installation is limited to localities near an A.C. current supply. As a rule high initial cost makes this type of generator unsatisfactory.

Where fuel is reasonably inexpensive and can be obtained in sufficient quantities, the gas motor generator set can be installed to an advantage. Generators may be installed at pipe-line pump stations and run from the fan belt of the engine of the pump. If the pump engine runs continuously, this type of current supply is ideal in that labor costs as well as prime mover costs are negligible. Many pump stations are not run continuously, however, and the use of this method is limited in that respect.

Metals higher than iron in the electrochemical series may be bonded to the pipe line at intervals and protection of the line obtained from such a hook-up. Zinc, one of the more common metals, is positive to iron by .33 volt. In series with iron, the zinc polarizes it, and in this way some corrosion problems may be easily solved. Usually, however, this type of protection is used on small, local problems.

To study corrosion of pipe lines, one must study the anomalies of electric po-

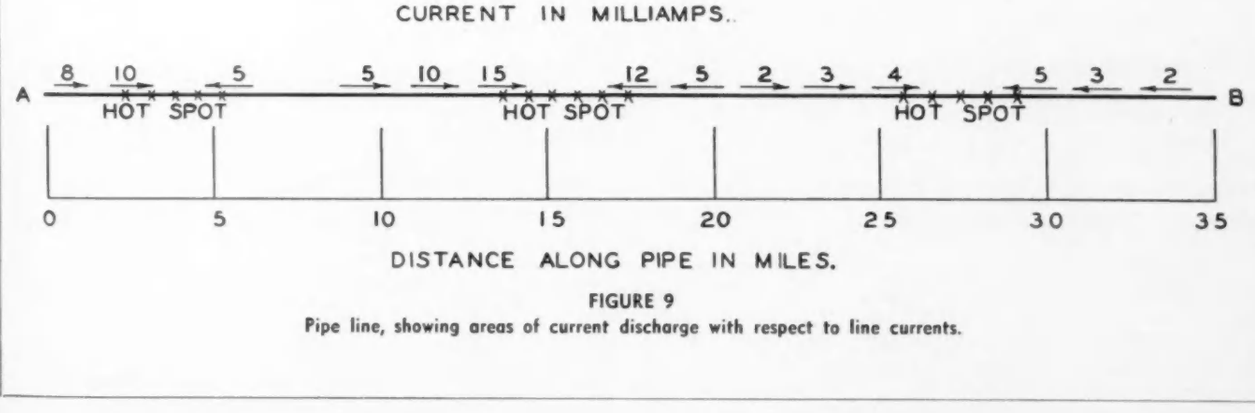

FIGURE 9
Pipe line, showing areas of current discharge with respect to line currents.

tentials existing at various points on the lines. To obtain line potentials, one needs only a voltmeter, a steel rod, a non-polarizing electrode, and two wire leads. A reading can be taken between two steel contact rods, one piercing the pipe scale or coating, for contact with the pipe, and the other making direct contact with the ground. As current flows through the circuit thus made, polarization will set up at the ground rod and the reading will be erroneous because of the drop in potential affected by the polarization. To offset errors in this manner, the non-polarizing electrode is used for the ground contact. Copper sulfate electrodes, designed especially for this use, may be obtained.

The potential difference between the copper sulfate electrode and steel is approximately .55 volt. To obtain the correct potential, the .55 must be subtracted from the voltmeter reading. If the line is charged by at least .25 volt negative to the ground, protection is secured. Under that condition the voltmeter must read .80 volt negative.

When potentials are obtained at all points along a given line, all anodic areas will be located. Distance, plotted against potential difference, will form a curve that denotes the direction of the pipe-line currents. The amperage of long-line currents is found by using a known length of pipe and measuring its potential drop. By Ohm's law, the amperage is calculated from the measured potential drop and the known resistance of the given length of pipe. A potentiometer is used preferably in this measurement because no current is used in taking the reading, thus eliminating any error from polarization. Current flow characteristics are plotted against distance, and the curves formed will reveal the anodic areas by converging currents. Both methods are used extensively, with preference usually given to the earth to soil measurement method because of its simplicity and wider application.

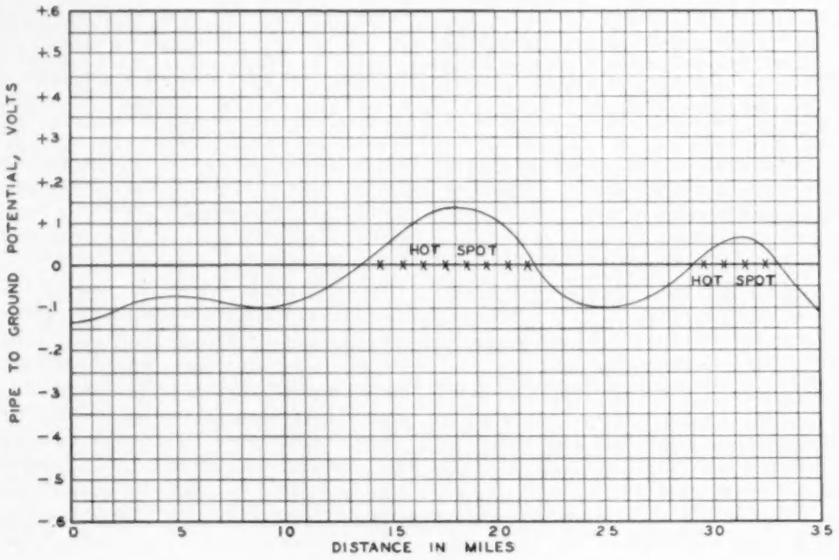

FIGURE 10

Pipe potential curve, showing areas of current discharge on pipe line.

Hot Spots

Points of current convergence, or anodic areas, are known in the industry as "hot spots." They must be watched closely, and protection must be given to them. Tank farms, pump stations, stream crossings, and areas of acidic ground water are the most probable areas of current convergence.

Occasionally it is impossible to obtain protection at "hot spots" from cathodic-protection units. When this is the case, the line should be insulated from currents generated at points remote to the "hot spot." To accomplish proper insulation, the boundaries of the area are located and insulating flanges installed in the line at these points. Insulation will not cut out all of the corrosion but will limit the cause of corrosion to local or short-line currents.

Tank Bottoms

Tank bottoms are excellent anodic areas, and, with combined local and long-line currents to join in corrosion, are pitted in short order under certain conditions. Pipe lines should be insulated from tanks for this reason. Sometimes it is considered an economic step to install protection units to care for tank bottoms where the tank farm is located in an extremely corrosive soil. At times the tank bottoms can be completely protected by bonding zinc anodes around the skirt of the tank. If this is done, the zinc must be well grounded and kept clean of its own corrosion.

Electric energy, obtained from the corrosion of zinc, has been found to cost about 65 cents per kilowatt hour, while generating a voltage of .32 volt. Compared with electric power, this would seem costly, but the efficient process in the electrolytic action of the zinc overcomes this high cost. An output of 5 volts from the rectifier may produce about .25 volt from the pipe to the ground. Assuming a 50 percent efficient rectifier, the overall efficiency will be about 2 to 3 percent. Installation costs together with equipment costs combine to make the zinc anode system economical as compared to the other types of protection for small corrosion problems.

In many cases paint and coatings can be used expediently in remedying the problem of corrosion. Where coal tar, asphalt, or paint coatings are applied to equipment, they must be applied with extreme care. Moisture and air, with or without some products of corrosion, trapped beneath the coating will cause corrosion. The corrosion will spread laterally until the air and moisture will have spent themselves. At that stage it is probable that the coating will have become cracked or broken, allowing the elements of the atmosphere to enter and augment the corrosion already in progress. Metal surfaces must be prepared and should be primed with an adherent primer before the coating is applied.

Hundreds of miles of pipe line must be either replaced or reconditioned each year because of corrosion. The expense to the industry is tremendous. Since modern civilization is dependent upon pipe lines, when one fails there is the possibility of a shortage of products necessary for modern living; the loss of property; and above all, the loss of human life. Research, therefore, can not place too great an importance upon corrosion and the methods by which it must be subdued, for there will always be those natural forces acting in its favor against industry and industrial development.

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Influence on Ultimate Recovery Of Extraction Methods

By S. F. SHAW, Consulting Engineer

IT IS logical to assume that some methods of oil extraction will increase the ultimate recovery in a greater degree than the use of other methods, and instances are often cited to prove that this result has been accomplished. In most cases, however, it is not so absolutely certain that such has been the result since incontrovertible proof would depend upon repetition of the extraction performance under similar and under dissimilar conditions in the same field before such proof would be considered by all concerned as indisputable. This procedure, of course, is impossible to carry out.

In the writer's opinion, too much reliance has been placed upon laboratory experiments for proving that some given method of extraction is preferable to some other method. Laboratory experimentation is undoubtedly a valuable adjunct to the acquiring of a better understanding of the actions that take place in an oil reservoir, and yet laboratory methods cannot take into account all the conditions that apply to a given sand, and, therefore, are prone to overlook some of the most important relations that exist between various factors in a reservoir. While laboratory research is to be encouraged as applied to the study of the behavior within a reservoir, this should not be made largely the basis for operating a pool.

It must be recognized first and last than an industry as vast as the oil industry must be built upon the principle of making a profit. No one will supply funds with which to carry out such a venture unless he believes he has a fair chance to get his money back with a good rate of interest, and with the underlying feeling that if the chance is hazardous, the profit must be commensurately high. An assured profit in such a venture is dependent upon taking several chances, most of which are likely to result in losses, which losses must be recouped through a large profit in the one venture that is successful. Amount of production, price of oil, expense of production taken together with ultimate recovery have been, and probably always will be the dominating factors that control the operation.

If ultimate recovery alone were the only factor to consider, we would change extraction methods completely. We would exhaust the gas as quickly as possible, perhaps, through bore-holes as at present, in order that work could be carried on safely in the reservoir itself, and then sink shafts and remove all of the sand to the surface, and extract from the sand practically all of the oil, thus resulting in an ultimate recovery of close to 100 percent. But this, except in isolated instances, would be unprofitable now, therefore, we are not employing this 100 percent extraction method.

Differences of opinion prevail as to whether wells should be spaced closely or more distant, and whether they should be produced at a high rate of capacity or at restricted capacity in order to obtain the maximum ultimate recovery. The factors involved lead to such complication of reasoning that it is not at all difficult to assert without fear of immediate and successful contradiction that a given method will bring about this result based on certain hypotheses, but when it comes down to actual facts, it is difficult to prove that either one method or the other brings about this result. It is possible, perhaps probable, however, that reservoir conditions are such that one method will accomplish the desired result in one field, whereas some other method will work to better advantage in another field.

Spacing of Wells

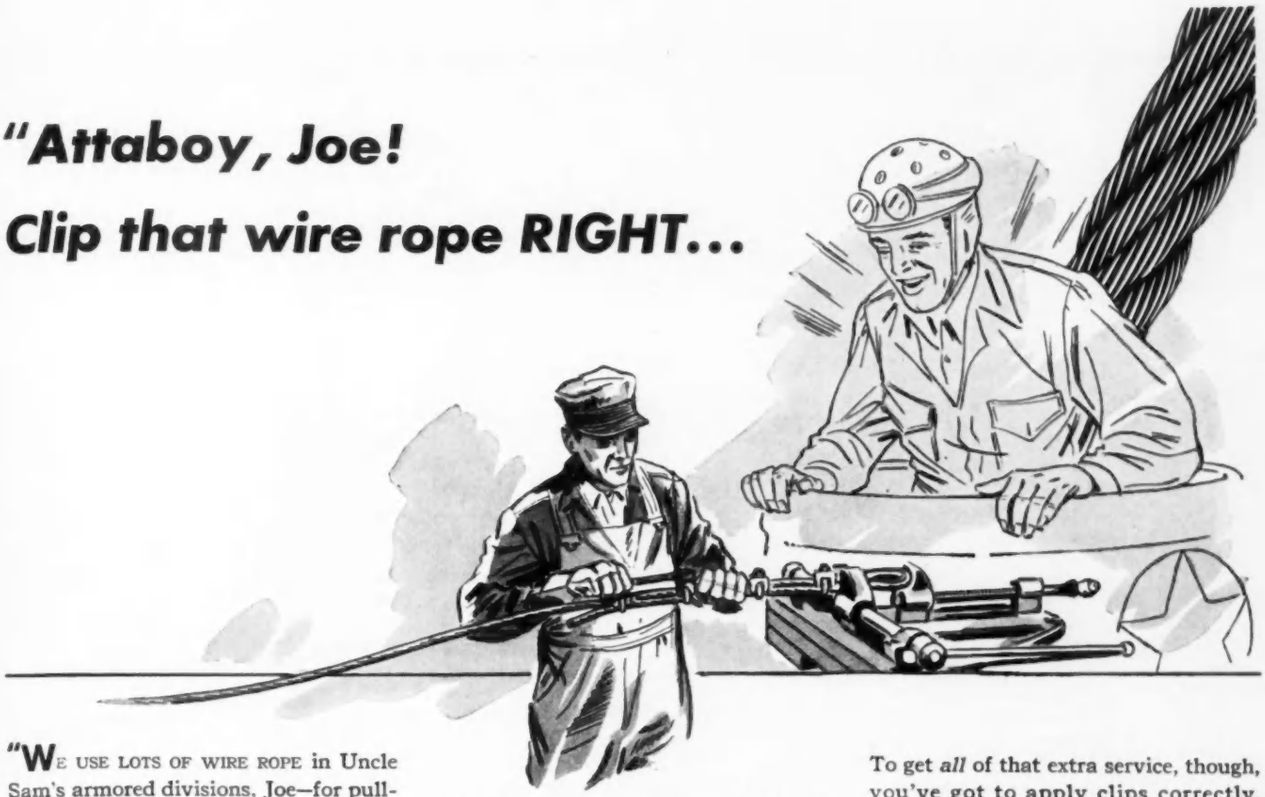
Well spacing probably enters to a large extent into the matter of ultimate recovery. In 1919, Beal[1] stated: "There has been considerable discussion of the necessity of such close spacing in salt-dome pools, but the writer believes that the practice is often justifiable because of the probable lack of communication between adjacent wells."

In 1921, Beal and Lewis[2] stated: "The greater the distance oil must be moved through the sand the greater the energy required, therefore, the gas in the property could not expel as much oil as if there were more wells." Also they stated: "It is possible to obtain a greater quantity of oil from an area, in a shorter time, by close drilling, yet it may not be profitable to do so. A larger amount of oil per well can be obtained at lower drilling and operating cost by wider spacing. The value per acre of the additional oil gained by drilling wells closer together must be balanced against the cost of drilling and operating the larger number of wells necessary to obtain the increase. . . . So far as spacing is concerned there is a balance to be reached between the quicker and more complete recovery by close spacing, and the cost of the additional wells involved. . . . This uncertainty makes too fine calculations of other factors absurd, for what is the best spacing for one price of oil will not be the most profitable for another price; therefore, the spacing for one period in the well's history may not be the best in another period. . . . It is to be noted (in referring to the acreage drained per well from 58 properties) that the closer the well the greater the amount of oil that will be taken from each acre in the same time. Although this fact should be self-evident, such a demonstration of the rate of increase in total production per acre with the decrease in acreage drained per well is valuable."

The above comments by Beal and Lewis in 1921 present a clear exposition of the subject of well spacing and are as applicable and true to facts at present as in the early days of high demand compared with supply.

In 1924, Cutler[3] after a lengthy study of well spacing in various oil-producing areas stated: "Average production-decline curves drawn for the widely-spaced and the closely-spaced wells indicate a decided increase of production per well in favor of wide spacing. This increase of production per well, is however, accompanied by a lessened recovery per acre. . . . The following tentative rule is deduced from the above examples: The ultimate production for wells of equal size in the same pool, where there is interference (shown by difference in the production decline curves for dif-

"Attaboy, Joe!
Clip that wire rope RIGHT...



"WE USE LOTS OF WIRE ROPE in Uncle Sam's armored divisions, Joe—for pulling out of tight spots, for towing disabled tanks and trucks, for handling heavy replacement parts . . . And we use it right and *fasten* it right, because we know men's lives in battle may depend on its being just as strong as it's supposed to be!"

Keeping wire rope "just as strong as it's supposed to be" is important *wherever* wire rope is used—on fighting front or production front! One factor in rope strength is correct fastening. *Properly used,* clips make a convenient and satisfactory fastening, developing 75 to 90 per cent of the rope strength.

When we build "Blue Center" Steel Wire Rope here at Roebling, we put in all the *extra* value of 100 years of wire-rope engineering. But even "Blue Center" Steel Wire Rope can't give extra service unless *enough* clips are used in fastening. The table below gives data for clipping "Blue Center" Wire Rope.

NUMBER OF CLIPS REQUIRED FOR "BLUE CENTER" STEEL WIRE ROPES

Rope Diameter	Number of Clips	Spacing of Clips	Length of Wrench
1/2" to 5/8"	4	3 1/2" to 4 1/4"	12"
3/4" to 7/8"	5	5" to 5 3/4"	18"
1" to 1 1/8"	6	6 1/2" to 7 1/4"	24"
1 1/4" to 1 3/8"	7	8" to 8 3/4"	24"
1 1/2"	8	9 1/2"	24"

To get *all* of that extra service, though, you've got to apply clips correctly. Always use a standard wire-rope thimble. Put the clip U bolts on the dead end of the rope. Tighten bolts securely, but *do not crush rope!* Retighten all clips after an hour's full

running time and also at all regular inspections. By following these rules for proper clipping, you'll be helping to keep rope on the job for Victory.

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TABLE 1

Effect of Spacing on Estimated Ultimate Production in the Bartlesville-Dewey District, Oklahoma.

Spacing Acres Per Well	Initial Years Production Barrels	Ultimate Production Per Well	Ultimate Production Per Acre Barrels
15	4,000	14,800	987
10	4,000	14,200	1,420
7	4,000	14,000	2,000
5	4,000	11,300	2,260
3	4,000	9,750	3,250
15	2,000	7,770	513
10	2,000	7,770	770
7	2,000	7,770	1,100
5	2,000	6,100	1,220
3	2,000	5,180	1,727
15	1,000	3,850	257
10	1,000	3,850	385
7	1,000	3,850	550
5	1,000	3,160	632
3	1,000	2,630	876

ferent spacing) seems approximately to vary directly as the square root of the areas drained by the wells. . . . The recovery from wells of equal size producing under similar conditions in the same pool is proportional to the average distance that the oil moves to get to the well. From this rule it follows that where interference exists between wells, doubling the distance between wells doubles the ultimate recovery per well and halves the ultimate recovery per acre. . . . This (tentative) rule seems to rest on the fundamental mechanical law that the energy required to move a fluid (either liquid or gas) through a pipe, or analagous conductor, is proportional to the distance. . . . According to this theory, doubling the spacing means doubling the distance the oil must be forced to the well, and inasmuch as the proportion of gas energy to the well is not increased, it would naturally be expected that the energy would be effective to only one half the degree and hence results in only half the recovery, which accords with the facts.

"Of the fields examined, the Speechley field, Butler County, Pennsylvania; the pools in Nowata and Rogers counties, Oklahoma; the Bartlesville-Dewey district, Oklahoma; the Hewitt field, Carter County, Oklahoma; and the Buena Vista Hills area, California, furnish typical examples of the difference in production that may be expected from wide and from close spacing. Examples of the effects of different spacing programs in these various pools are given in Tables 1 to 7.

When one studies the recovery in the shallow and perhaps rather tight sands in the Appalachian region and in the Bartlesville sand of Oklahoma and Kansas, and observes how cores taken between wells with five-acre spacing show almost no drainage of oil, it is difficult to believe that wide spacing will result in as high recovery as close spacing. Where secondary recovery projects have been undertaken in such fields, it has been found that profitable outcome and, particularly, higher recovery often is dependent upon drilling more wells than are called for in the spacing employed by the primary method. If closer spacing had been used in the primary-recovery method, probably less oil would have remained for the secondary method to recover. The writer has observed wells drilled in the Bartlesville sand at distance of only 50 feet from the original well, after an interval of 5 to 10 years, to come in for an initial of 50 to 75 percent of the initial of the first well. It is difficult to believe that wide spacing in such instances will result in other than low recovery.

In some discussions, the theory has been advanced that wide spacing will result in higher ultimate recovery[4] and reference has been made to statements that early procedure with close spacing and high-capacity production has resulted in recovery of 20 percent or less. Review of these early figures has shown that these early estimates have no bearing whatever on the ultimate recoveries that have been made from the general character of reservoirs developed since the days of shallow reservoirs with tight sands to which such recovery percentages applied. Moreover, it has been demonstrated even in these tight sands, that by using secondary-recovery methods, these figures have been greatly increased above the 20 percent that has been mentioned from time to time.

Statements have been made that one well theoretically is sufficient to extract all the recoverable oil from a reservoir in the course of time. Such a statement cannot be taken seriously as applied to an oil field since the word "theoretically" itself eliminates such procedure from practical operations. No operator could profitably await the recovery under such conditions. Moreover, any one having practical experience knows of the production tribulations taking place in any well in the course of a long time, caused by sand choking up around the well; through paraffin depositions; through corrosion and collapsing of casings. When it becomes necessary to produce considerable water, the opera-

TABLE 2

Variation in Production per Acre with Different Spacing of Wells in the Bartlesville Field, Oklahoma.

Average Acreage Per Well	Production Per Well First Year Barrels Per Day	Daily Production Per Well First Year Barrels	Average Thickness of Sand Feet	Average Total Production Per Acre Barrels
2 to 4	11 to 20	14	26	2,930
5	11 to 30	14	27	2,550
6 to 8	11 to 20	15	26	2,090
3 to 4	21 to 30	24	27	6,500
5	21 to 30	26	30	5,650
6 to 8	21 to 30	25	28	3,000

TABLE 3

Variation in Production per Acre with Different Spacing of Wells in the Glenn Pool, Oklahoma.

Average Acreage Per Well	Production Per Well First Year Barrels Per Day	Daily Production Per Well First Year Barrels	Average Thickness of Sand Feet	Average Total Production Per Acre Barrels
5	0 to 10	6	35	1,000
6 to 10	0 to 10	7	36	880
6 to 7	21 to 30	24	28	2,320
8 to 10	21 to 30	23	46	2,070

TABLE 4

Effect of Spacing on Ultimate Production in the Hewitt District, Oklahoma.

Spacing, Acres per Well	Ratio of Ultimate Production per Well, Percent	Ratio $\frac{}{\sqrt{\text{Areas}}}$ Drained, Percent	Ratio of of Ultimate Production per Acre, Percent
10	100	100	50
2½	50	50	100

TABLE 5

Effect of Spacing on Ultimate Production in the Nowata District, Oklahoma.

Spacing Acres Per Well	Initial Years Production Barrels	Ultimate Production Per Well Barrels	Ultimate Production Per Acre Barrels
10	6,000	16,900	1,690
8	6,000	15,200	1,900
6.3	6,000	14,300	2,386
10	4,000	12,200	1,220
8	4,000	10,900	1,366
6.3	4,000	10,300	1,717
10	2,000	6,900	690
8	2,000	6,100	766
6.3	2,000	5,700	950

TABLE 6

Effect of Spacing on Ultimate Recovery in the Speechly Pool, Pennsylvania.

Spacing Acres Per Well	Initial Years Production Barrels	Ultimate Production Per Well Barrels	Ultimate Production Per Acre Barrels
10	1,600	9,300	930
6	1,600	7,850	1,308
10	1,000	6,500	650
6	1,000	5,600	933
10	800	5,400	540
6	800	4,800	800

TABLE 7

Effect of Spacing on Ultimate Recovery in Buena Vista Hills, California.

Spacing Acres Per Well	Initial Years Production Barrels	Ultimate Production Per Well Barrels	Ultimate Production Per Acre Barrels
Isolated	200,000	1,030,000	25,750
10	260,000	600,000	60,000
Isolated	172,000	742,000	18,550
10	172,000	413,000	41,300

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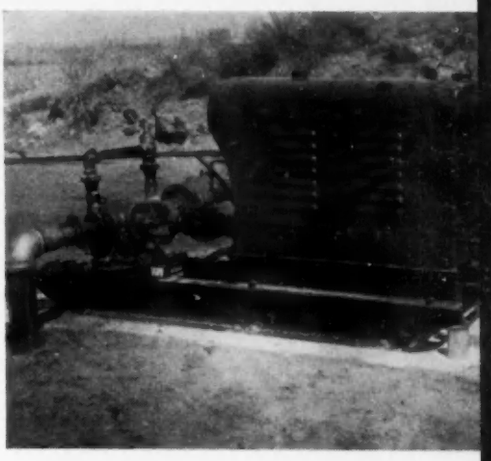

But buy "small engines" wisely, don't just look at the size and price, look at the ACTUAL WORKING POWER output of the engine. Determine the power required to pump a well, drive a generator or a pipe line pump, using *actual* working conditions, convert it to "foot pounds torque" and then check it against the power curves of ALLIS-CHALMERS ENGINES. It's *very* probable that you'll find an Allis-Chalmers "small engine" with plenty of ACTUAL WORKING POWER to do the job.

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TABLE 8

Data on Areas with Different Spacing in the Long Beach Field.

AREA	Acres in Area	Number of Wells	Acres per Well	BARRELS RECOVERED TO JULY 1, 1929		
				Total	Per Well	Per Acre
A	70	24	2.92	6,397,665	266,569	91,395
A'	70	98	0.71	13,759,127	140,399	196,558
B	20	6	3.33	1,399,827	231,638	69,990
B'	20	24	0.83	5,471,061	227,961	273,553
C (a)	20	6	3.33	2,824,113	470,685	141,206
C (a)'	20	23	0.87	3,621,756	157,468	181,088
C (b)	20	8	2.5	1,655,407	206,926	82,770
C (b)'	20	20	1.0	2,760,981	138,050	138,050
D	15	5	3.0	737,020	147,404	49,135
D'	15	17	0.88	2,335,581	137,387	155,705

tion of a single well to recover the oil would become so unprofitable that it would have to be abandoned, no matter how much oil there remained in the reservoir.

Even with the porous, highly-permeable and thick Wilcox sand in the Oklahoma City field, it has been found in the later life of the field, that side-tracked wells with deviation of 50 to 100 feet have often resulted in large increase in production over the quantity being produced through the original hole even though this field has been developed with close spacing. There is a limit, of course, to the distance to which it is practicable to carry on side-tracking operations in such a field. It is difficult to interpret such results as other than increase in ultimate recovery brought about by very close spacing.

The Turner Valley field, Canada, with a very tight reservoir, is one in which spacing has been on basis of 40 acres per well. The results to date seem to the writer to indicate that the yield will be perhaps 50 percent of what would have been the recovery had the spacing been on basis of 1 well to 10 acres. However, with the prevailing price for oil and with cost of drilling amounting to between $150,000 and $200,000 per well, it would not be profitable to drill four wells to double the recovery that appears likely to be obtained from one well. In this connection it will be interesting to observe the results obtained later in such fields as Wasson, Slaughter, Magnolia, and other similar limestone fields which have been developed on basis of 40 acres to the well.

Wells in various fields of the Los Angeles Basin have been spaced at very close intervals. The most prolific field so far exploited has been Long Beach, and reservoir recoveries with different spacing programs are given in Table 8.[5]

There has been considerable discussion as to the validity of the comparisons in Table 8, and yet the great differences in recovery for the different spacing programs seem to point definitely toward the fact that greater recovery was obtained with closer spacing.

Another prolific pool in the Los Angeles Basin is the Santa Fe Springs field, and data on production from three different zones with different wells are given in Table 9.[6]

It is quite possible that some of the oil in the closely-spaced areas noted in Table 9 is drained from surrounding and more widely spaced areas, but in areas where the widely-spaced wells are producing at unrestricted rates, it is difficult to see how the closely-spaced wells can drain so large a quantity from the adjoining acreage where the spacing also is quite dense, especially when the production per acre in the widely-spaced wells is as high as it is in these examples.

Higher ultimate recovery was considered as resulting from close spacing in California fields nearly 20 years ago, as indicated by an article written by Gester, Gester and Wagy[7].

It should not be forgotten that high ultimate recoveries have been made in many Gulf Coast fields where the spacing has been close, such as at Hull, Humble, Jennings, Orange, Sour Lake, Spindletop, Vinton and many others. Also let us remember that wells were spaced closely in fields along the Balcones fault zone, such as Powell, Wortham, Luling, Darst Creek, Salt Flat, and high per-acre recoveries have been made. In Powell and Wortham, ultimate recovery percentages appear to be on the order of 50 and 60 percent, respectively, even before making any allowances for gas and water content.

Uniformity in spacing is a very different matter from that of close spacing. In order to obtain equitable distribution in the recovery of oil as between contiguous property owners, it would seem as if the spacing should be uniform, whether the spacing be on a wide pattern or whether the spacing be close.

Recovery in Deep Reservoirs Compared With Shallow Reservoirs

Probably pressure conditions within a reservoir have much to do with ultimate recovery, and since the pressure in the reservoir is largely dependent upon the depth of the wall, it is logical to expect that the deeper the well, the wider can be the spacing to obtain the same percentage of recovery under otherwise similar reservoir conditions and similar lifting conditions as in a shallow field. Not only is the pressure higher with greater depth, but also the quantity of gas dissolved in the oil is likely to be greater than in a shallow field, and this gas serves the purpose of propelling the oil to the well, that is, to the point of lower pressure, as well as to lift the oil to the surface. It would seem logical to assume that the same spacing in deeper reservoirs will result in a higher ultimate recovery than from wells in shallow reservoirs where the pressure is low.

In 1919 Beal[1] stated: "Unquestionably a much larger percentage of the oil content can be recovered from the coarse porous sandstone subjected to a high pressure, than from a fine-grained denser sandstone under no pressure. The coarse, porous sand offers little resistance to the flow of oil toward the well, whereas with a fine sandstone and a low pressure, the production is retarded both by the greater frictional resistance and the lack of expulsive force."

In 1921 Beal and Lewis[2] stated: "The amount of oil recovered is influenced as much by the rock pressure and the amount of gas absorbed in the oil as by almost any other factor."

Definite data are not at hand which prove that recovery per acre is greater

TABLE 9

Production Data on Areas with Different Spacing in the Santa Fe Springs Pool.

ZONE	Area Acres	Number of Wells	Acres per Well	Barrels Recovered to 1932			Estimated Ultimate Recovery, Barrels	
				Total	Per Well	Per Acre	Total	Per Acre
Buckley	40	9	4.44				3,172,000	79,300
Buckley	35	30	1.19	3,938,000	131,300	112,500	4,365,000	121,900
O'Connell	39.9	7	5.71				5,825,000	146,000
O'Connell	35.5	40	0.89	10,200,000	255,000	287,300	11,800,000	331,900
Clark	40	8	5.0				2,440,000	61,000
Clark	35.7	42	0.85	5,223,000	124,300	146,300	5,723,000	159,000
Total	119.9	24	5.0				11,437,000	96,100
Total	106.2	112	0.95	19,361,000	172,900	182,300	21,888,000	204,200

TABLE 10

FIELD	Year Discovered	Acres	Total Barrels Recovered	
			To Dec. 31, 1941	Per Acre
Spindletop	1901	400	125,900,000	314,750
Jennings	1901	1,000	46,500,000	46,500
Sour Lake	1902	900	79,400,000	88,220
Humble	1905	2,300	126,800,000	55,000
Vinton	1910	285	43,400,000	152,500
West Columbia	1915	700	82,500,000	117,900
Barbers Hill	1916	500	72,700,000	145,400
Hull	1918	850	93,900,000	109,500
Total		6,935	671,100,000	97,000

in reservoirs of high pressure than in low-pressure reservoirs, but there are strong indications pointing in that direction.

Acidizing Wells

The practice of acidizing wells on a commercial scale completed in limestone reservoirs first started in Michigan in 1932 and has been of much benefit in opening the formation around the well bore, thus allowing oil more freely to flow into the wells, many of which otherwise would be too small to produce economically. Wells that have been abandoned have been put back on production by the use of acid[8] which is clearly a case of increasing the ultimate recovery.

Heithecker[9] states: "Acid treatment has caused a marked increase in the ultimate recovery of some of the old and nearly depleted fields of Kansas, owing to the cleaning-out action of the acid at the face of the limestone and the enlargement of the small drainage channels and probably the penetration of the acid to the previously undrained portion of the strata."

The old Fairport field in Russell County was studied in detail by Heithecker because the data were readily accessible. Heithecker has concluded that to the end of 1934 the estimated increased recovery per well in this field as a result of acidizing will be of the order of 20,000 barrels per well, or 2,000 barrels per acre.

Notable progress has been made in the use of this method during the past 10 years, and probably a large increase in ultimate recovery will have been made through the use of this method. This method is another instance of opening the well bore so that the oil can enter the well more freely, but this would serve no practical purpose unless the oil could be produced at a higher rate.

TABLE 11

FIELD	Year Discovered	Acres	Barrels Recovered to Dec. 31, 1941	Barrels per Acre
Luling	1922	2,110	77,213,000	36,600
Powell	1923	2,600	115,298,000	44,300
Wortham	1924	324	22,786,000	31,900
Hendrick	1926	12,138	201,782,000	16,600
Salt Flat	1928	1,250	42,701,000	34,160
Darst Creek	1929	1,860	52,424,000	28,200

Shooting Wells and Enlarging the Well Bore

In past years it was an accepted practice in wells completed in consolidated sand to shoot the wells with charges of nitroglycerine, thus serving to open the well-bore, and in sand wells has a beneficial effect parallel to the use of acid in limestone reservoirs. Laboratory experiments made by Uren[10] appear to confirm this theory. Data on gas-oil ratios in wells in the Seminole field, Oklahoma, taken before and after shooting wells, leaves no doubt that in many instances gas-oil ratios can be reduced by this practice.[11]

Influence of Rate of Production on Ultimate Recovery

Rate of production and its influence on ultimate recovery has been debated extensively. It is difficult to produce proofs that show definitely for a given field that either high-capacity methods or that restricted methods yield the maximum recovery. Much theory is offered in argument, but this does not constitute proof that is indisputable. Most of the older fields have been produced at capacity rates, and average recovery per acre up to the present time can be given, but very few large fields, if any, among those discovered since 1930, when restricted rates began to be really effective, have been produced to a point sufficiently close to depletion that any definite figures can be stated for per-acre recovery. Perhaps the best comparison that can be made in the course of time is that of the per-acre yields, or present estimates of per-acre yields, of fields discovered prior to 1930, with those discovered since that time, even though this basis of comparison is open to criticism.

Certain it is that per-acre yields are already high in various Gulf Coast fields discovered prior to 1930 where production has been at maximum capacity and where spacing has been close. A few of these fields in the Gulf Coast are noted in Table 10.[12]

Discoveries of large fields on the Gulf Coast since 1930 are those of Conroe, Friendswood, Hastings, Thompsons and Anahuac. In these five fields the total combined acreage assigned is 40,900, and estimated combined recovery is 2,121,900,000 barrels or an average of 52,000 barrels per acre.

A few other fields in Texas discovered prior to 1930 have produced as shown in Table 11.

There were no production restrictions of consequence at Powell or Wortham,

TABLE 12

FIELD	Year Discovered	Acres	Barrels Recovered to Dec. 31, 1941	Barrels per Acre
Hunt'gton Beach	1920	2,100	301,519,000	143,580
Long Beach	1921	1,600	666,990,000	416,780
Santa Fe Springs	1921	1,630	474,657,000	291,170
Domingues	1923	1,054	130,378,000	161,320
Ventura Avenue	1926	1,840	227,600,000	123,680
Total		8,224	1,801,144,000	219,000

and although there was a pretense of restriction at Hendrick, actually this was of little consequence, but spacing at Hendrick was wider than that of the other five fields in Table 11. Luling was closely spaced, and produced wide open for most of its productive life. Salt Flat and, more particularly, Darst Creek were prorated, though not to a very severe degree.

Recovery in a few fields in California discovered prior to 1930 has been as given in Table 12.

The fields in Table 12 were drilled with very close spacing, and production in the early years was at maximum rate, and the yields per acre are high.

There was an intensive campaign of rapid extraction throughout the major portion of their productive lives in the fields first drilled in the Tonkawa and Seminole fields and data on production were as given in Table 13.

When considering the thickness of sand in the Oklahoma fields noted in Table 13, the recoveries appear exceptionally good. In the Seminole field it was found by careful measurements that production at maximum capacity usually resulted in lower gas-oil ratios down to some minimum ratio. It was also found that gas-oil ratios were reduced by placing flowing wells on gas-lift, thereby increasing production and at the same time reducing the gas-oil ratio; this result was also found to apply in the Wilcox zone of the Tonkawa field. Tests made on wells in the Seminole area before and after shooting the wells revealed that in most cases production was increased and gas-oil ratios were reduced after the shooting took place.[11] Data in Table 14 illustrate this point.

It was found by a committee of engineers appointed in 1936 to examine into the matter of gas-oil ratios in the Oklahoma City field, that production

TABLE 13

FIELD	Year Discovered	Acres	Barrels Recovered to Dec. 31, 1941	Barrels per Acre
Tonkawa	1921	3,695	121,365,000	32,800
Seminole City	1926	4,635	128,848,000	27,800
Earlsboro	1926	5,235	125,465,000	24,000
Bowlegs	1926	4,270	118,900,000	27,900
Little River	1927	4,625	111,745,000	24,200
St. Louis	1927	19,825	154,550,000	7,800

TABLE 14

Effect on Gas-Oil Ratios Produced by Shooting Wells in the Seminole Area.

WELL	Oil Production, Barrels per Day		Gas-Oil Ratios, Cu. Ft. per Bbl.	
	Before Shooting	After Shooting	Before Shooting	After Shooting
A	335	677	1,320	853
B	454	671	850	675
C	368	606	1,290	881
D	382	854	1,923	1,518
E	687	602	1,264	1,530
F	788	1,475	600	444
G	395	724	973	698
H	732	1,969	548	654
I	171	279	970	900
J	181	228	2,250	2,450
K	206	497	2,580	1,591

at maximum rates usually resulted in minimum gas-oil ratios. The following statement regarding this matter is found in the report: "A principle stated previously is borne out by experience here, viz., that the most efficient gas-oil ratio is obtained at the highest rate of flow." There were exceptions, it is true, but exceptions were greatly in the minority. It is also proper to state that this principle is not necessarily applicable to all oil fields.

Much argument has been advanced to support the method of restricting production on the basis of this being the means of obtaining the maximum use of the energy in the gas associated with the oil in the reservoir, and the impression seems to prevail that restricting the wells to a low rate results in the optimum use of the energy in the gas. Some comments on the subject of gas energy may have a bearing on this matter. The approximate number of foot-pounds of work performed when one cubic foot of a perfect gas expands isothermally from a given gauge pressure to atmospheric pressure at sea level is given in Table 15.

From this table it appears that the energy available in one cubic foot of gas expanding from 3,000 to 2,000 pounds is 878 pounds, or not quite the equivalent of one cubic foot expanding from 8 to 0 pounds pressure. Or, if the expansion be from 200 pounds to 50 pounds, the work amounts to 2,539 foot-pounds which is the equivalent of the work performed when 1 cubic foot expands from 3,000 to 900 pounds per square inch. Or again, one cubic foot of gas expanding from 100 pounds to atmospheric pressure provides as many foot-pounds of work as 5 cubic feet expanding from 3,000 to 2,000 pounds per square inch. Since energy is measured by foot-pounds of work, it appears that the work performed by 1 cubic foot of gas at the higher pressures in propelling oil through the sand is far less potent than when this quantity of gas propels oil at a lower pressure. This brings out the point that maintaining high back pressures at the bottom of the well may not allow the gas to function as efficiently in moving the oil through the sand as when the pressure is held at a lower point. Of course, back pressures cannot be reduced, as a rule, without increasing production, and when there is an over-supply of oil, the wells must be restricted in order to keep the supply close to the demand rate even though it be at the expense of efficiency in the use of the gas.

It has been contended that allowing the gas to move toward the well at a high rate of velocity results in reduced efficiency and in by-passing the oil. This statement has neither been proven nor disproven. We may be reminded, however, that water flowing down a stream bed with a low velocity may not even move small grains of sand, but if the volume becomes sufficiently great as to set up a high velocity, even the largest boulders may be transported long distances. May this not also be true to some extent in the movement of oil through a reservoir?

It has been shown by experiment that the washing of an oil sand with water at a high rate of velocity is more effective in cleaning the oil from the sand than if the action be at a slow rate.[13] H. C. Miller in commenting on these experiments stated: "Idealized laboratory experiments performed by Miller show that within the usual rate of edge-water encroachment in oil reservoirs the faster the rate of water movement in an oil-filled sand column the greater the percentage of oil recovered."

Attention has been called to this same condition by Harry M. Ryder[14] in connection with water-flooding operations in the Bradford field. If this be true of artificial water-flooding operations, it would appear that it should also be true of natural water floods.

Use of Large Casing Diameters for Producing at High Capacity

For extracting oil or water at a high daily rate, especially in thick and porous formations, it has been found that the use of a large casing is preferable to one of small diameter, particularly in deep wells. Gas-lift operations at Seminole demonstrated this point in a definite manner and to an extent not before realized.[15] This was verified in the Oklahoma City field where very large potentials were established, and at periods very large production of oil was lifted at high capacity over a few days to lift the allowable for the month and then the well was closed in. This point was demonstrated also at Corpus Christi (Saxet Heights field) where the use of a larger casing for lifting large quantities of liquid resulted in lower gas-factors for lifting the fluid than in the smaller sizes of casing,[15] and this enabled wells with larger casings to continue on production at a profit for a considerably

TABLE 15

Foot-pounds of Work Performed by a Perfect Gas Expanding Isothermally from a given Pressure to Atmospheric Pressure at Sea-Level.

Initial Pressure Lbs. per Sq. In.	Foot-pounds of Work Performed	Initial Pressure Lbs. per Sq. In.	Foot-pounds of Work Performed
3,000	11,294	1,300	9,512
2,900	11,207	1,200	9,344
2,800	11,123	1,100	9,163
2,700	11,057	1,000	8,964
2,600	10,977	900	8,744
2,500	10,885	800	8,499
2,400	10,798	700	8,222
2,300	10,710	600	7,902
2,200	10,616	500	7,527
2,100	10,518	400	7,069
2,000	10,416	300	6,486
1,900	10,308	200	5,676
1,800	10,194	100	4,349
1,700	10,074	50	3,137
1,600	9,947	20	1,819
1,500	9,812	10	1,107
1,400	9,667	1	139

longer time, and thus increase the ultimate recovery, before it was necessary to abandon them. Later, it was found in the Saxet field that in sands producing considerable volumes of water, extraction through a large casing could be continued economically for a longer period than through small casing before abandonment became necessary.

The subject of optimum size of well-casing is likely to come up for closer study when deep wells along the Gulf Coast have declined to the point that artificial lifting of the fluid becomes necessary. The use of 5½-inch casing has been largely adopted on the Gulf Coast on the score of more economical completion of wells, but it seems very possible that this practice may result in a considerably lower ultimate recovery and perhaps in considerably reduced ultimate profits. Other factors applying to the use of large casings are discussed by E. K. Parks[16] and L. E. Porter.[17]

Production at Restricted Rates

During periods when the producible supply greatly exceeds the demand, it would, of course, be financial suicide to insist on producing wells at maximum capacity even though high capacity may result in increasing the ultimate recovery. One of the very serious effects of highly restricted production is the inability to determine whether wells should be drilled in the less favorable portion of a structure. Many venturesome souls become obsessed with the idea that if the pressures in a reservoir are fairly high at a given time, even though this be an artificially-maintained pressure caused by restriction and by water-drive, that wells can continue to be drilled down the flank of a structure until the point has been reached where practically nothing but salt water can be produced. Parts of Saxet, McCampbell, KMA and some West Texas fields bear out this point, and yet it seems easy for reckless promoters to finance drilling campaigns even with banking

support, on the basis of having a high pressure (but only a little oil). It is not difficult under such conditions to defend the fictitious hypothesis that the only reason the wells are not producing more oil is because of restricted allowables.

While operating under restricted allowables, production-decline curves are of little value, and reserves set up on the basis of volumetric estimates do not come in for correction until too late to remedy bad production practices and conditions, or to point out serious errors made in the early estimates of recovery.

Theories as to how wells should be produced in order to use the gas to maximum advantage in order to obtain the maximum ultimate recovery are raging furiously at this time. Some theories even touch on the border of keeping the cake and still enjoying it, and many of the theories that are advanced border on the nonsensical and show little understanding of the practical side of oil-field operations.

In various instances, the testimony offered before the various regulatory bodies as to the effect of gas and its application to ultimate recovery are so inconsistent as between geologists and engineers of equal professional standing that those having no financial interest in the particular proceedings wonder whether there is not a great deal of "bunk" in the entire proceedings. In fact, commissioners of some of these regulatory bodies have expressed this idea to the writer.

Secondary Recovery Methods

After wells producing by so-called primary methods have reached the point where they would normally be abandoned, it stands to reason that ultimate recovery is increased by the adoption of any method that will continue the production at a profit, and secondary methods in many instances have become the means of increasing to a considerable extent the ultimate recovery of oil. Three methods have been employed, known as water-flooding, air- or gas-drive, and mining the sands, the latter having not yet made much headway except at Pechelbronn in France, and Wietze, in Germany.

Water-Flooding

Water-flooding is by no means a recently discovered method. Lewis[18] states: "Flooding is excellently described by Carll[19] (in 1880) and other early writers who note the effects of flooding at Pithole and in other early fields in Pennsylvania. Carll outlined the principles of flooding and came to the conclusion that terminating the life of a nearly exhausted well by displacing the remaining oil with water was sound in theory. Practically the same views have been held by Huntley and Johnson[20] and others who maintain that the fault lies not in the theory but in the attempts to concentrate the oil by flooding without sufficient data as to underground conditions. Among oil producers themselves, outside of the Bradford field, flooding has been regarded with almost universal disfavor because of their many unfortunate experiences . . . The most notable of the floods which occurred in the early fields was at Pithole. The flood was caused by lack of effective ways of excluding water and through lack of knowledge of the effects of large quantities of water entering the oil-bearing formations. The flood advanced rapidly and irregularly, and within a period of a few years almost the whole field was drowned out. Some of the wells in the path of the water showed remarkable increase in yield before being drowned, but attempts by operators to foretell or to control the movements of the water were usually unsuccessful."[18]

The early attempts at water-flooding at Bradford were not all successful. Later this method was put into use in a definite way by introducing water from the surface, and studies of control methods were made to determine the best manner in which to apply the flood. The classic example of the use of this method is Bradford, where ultimate recovery has been greatly increased; in some instances following the use of air-drive, in other instances with accompanying air-drive, on the same or adjacent leases. When this work was started in Pennsylvania, the price of oil was $3.00 or $4.00 per barrel, and the estimates gave promise of a highly profitable outcome, but in various instances the high prices paid for leases, followed by greatly reduced prices for oil, changed the financial outcome to a considerable extent.[21] However, there is no doubt as to there being an important increase in ultimate recovery brought about by this method, whatever be the economics involved. To the end of 1915, over a period of 46 years, recovery at Bradford had been 230,000,000 barrels, or 2,700 barrels per acre; in 1941, 15 years later, the recovery had reached a total of 462,000,000 barrels, or 5,400 barrels per acre, or twice that which had been recovered at the time when water-flooding methods were beginning to get into action.

In May, 1931, the water-flooding method was introduced into Oklahoma by Bert Collins on some leases of The Carter Oil Company, near Chelsea. This was followed by other examples of water-flooding, particularly in various pools of the Nowata area in the Bartlesville sand, and in some Bartlesville-sand pools in Kansas where low recoveries had been obtained by primary methods. Again there was an important increase in ultimate recovery, but due to rather high costs for preparing wells for the purpose, for drilling new wells on closer spacing, and because of the low price for oil, the financial outcome in some instances has not been as favorable as could have been desired.[22] Nevertheless, this work has demonstrated that oil which has been left behind during primary operations in many fields, with adequate price for oil, and with a technique better understood, can be recovered partly, at least, by water-flooding, gas-drive, and perhaps some other methods yet to be tried out; consequently this oil is not to be considered as lost in many of these older fields where recovery had to cease through failure to show a profit. It would seem as if it were better that old fields not showing a profit should not be produced, but should be allowed to await a more propitious time for recovery of the oil. Oil fields of a character that cannot show a fair profit when operating under present methods, should not be operated at a loss, but should await a more favorable time for being exploited.

In connection with the higher recovery obtained by water-drive, it should be remembered that even closer spacing than in the primary method is often required to employ this method to advantage. It seems to be thought advisable to flood the reservoir rapidly and flush out the oil quickly in order to attain maximum recovery.[13] Late experiences in the Bradford field are cited by Ryder[20] who states: "A large amount of analyzed data furnishes convincing evidence of the great advantage in production to be obtained by maintaining a water-drive at or above its optimum velocity. . . . A higher yield will result from the rapid flooding."

Air- or Gas-Drive Method of Secondary Recovery

A method that has been employed in a large number of instances for increasing production by secondary methods is that of the so-called repressuring method, or air- or gas-drive, as it might more appropriately be termed. The earliest recorded experiment[18] seems to have been carried out by I. L. Dunn in 1903 when he injected gas at 45 pounds pressure in a well in the Macksburg pool, Ohio. When the gas was released the well began to pump much oil which continued until the gas had worked out again. This experiment was followed by a test made by I. L. Dunn in 1911 on the Wood farm of the Cumberland Oil Company near Chesterville, Ohio, when the gas was injected into one well with the idea of driving the oil to another well where it would be produced.

The air-drive method gradually spread over various sections of Ohio, West Virginia and Pennsylvania, then into Kan-

sas, in 1922, and into the Nowata area of Oklahoma where it was employed at an early time in 1924 at the Elliott pool.[24] It is now being employed in various parts of Oklahoma, Kansas, Texas and Louisiana.

Repressuring was started in an area of the old Burbank pool in 1926 and a gradually expanding and successful use was made of the method.[25] Figure 1 shows a graph of a lease of 16 wells in a Mid-Continent pool, where repressuring was started in 1929 in which the primary production as indicated by the logarithmic decline curve would have reached 10,000 barrels per year for the lease about the year 1934, at which time probably it would have been unprofitable to produce the lease at prevailing prices for oil. The effect of the gas-drive became evident in 1930, and after the lapse of sufficient time to observe the effect, it appeared that the point of depletion to 10,000 barrels per year would not be reached until about 1948, and the increased production during this time would amount to 260,000 barrels, or 20 percent of the recovery that was estimated as recoverable without the aid of gas drive up to the end of 1934. In this instance no additional wells were drilled, but in the Nowata area and in other areas it was found desirable to drill additional wells to enable the air-drive to attain the best results.

Very successful results in the use of the air-drive were obtained in the old Delaware Consolidated pool in the Nowata area where the pool for the most part was unitized.[26]

An important experiment was conducted by Humble Oil & Refining Company at Olney, Texas, on two leases in which the production had declined to depletion and on which a vacuum had been applied as long as it was profitable. The reservoir pressure in these two leases was at 0 pounds per square inch when repressuring was started, and it was restored to approximately the original pressure of about 350 pounds per square inch by the injection of about 109,000,000 cubic feet of gas before production began. Some 202,889 barrels of additional oil were thus recovered up to October 24, 1938, when the reservoir pressure again was down to atmospheric pressure and the work was discontinued. The primary methods had accounted for a production of 349,140 barrels, or about 4,400 barrels per acre; subsequent recovery was 2,550 barrels per acre, making for an increase of 58.1 percent over that of the primary method. Estimate of output gas to lift the oil was as low as 300 cubic feet per barrel[27]; the actual quantity was 9,319 cubic feet per barrel, but 97.1 percent of this output gas was recompressed and returned to the reservoir and the difference in quantity between input and output gas was 267 cubic feet per barrel. Whatever be the comparison between estimates of output-gas factors with those actually obtained, or whatever was the financial outcome, this work demonstrated that an important increase in ultimate recovery could be made, and would be made, when economic conditions become favorable.

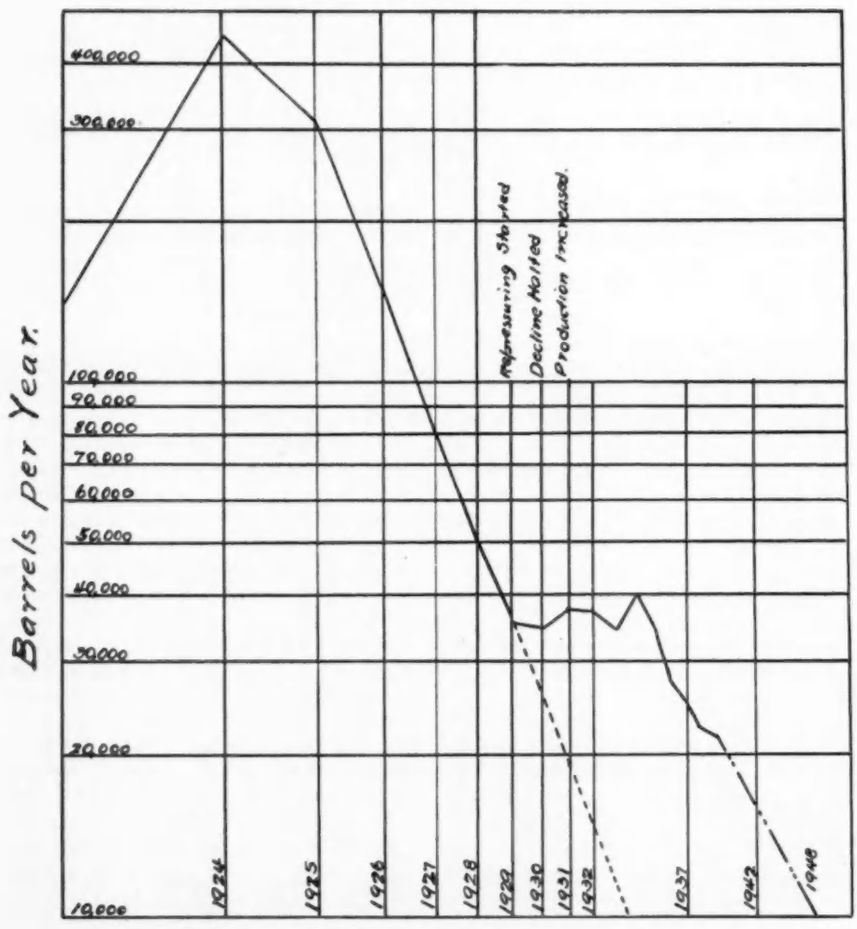

FIGURE 1
Production curve of a lease in the Mid-Continent which was repressured.

Pressure Maintenance

So far as records go, conception of the use of pressure maintenance can be attributed to Henry L. Doherty and his engineers who were the first to study the method from the practical point of view, as evidenced by patents for which applications were made in 1925.

The first large-scale trials seem to have been made by Humble Oil & Refining Company at Sugarland and Raccoon Bend, Texas, and by the Nederlandsche Koloniale Petroleum Maatschappij in Sumatra, where operations were started in 1928. This method has been employed also by Humble Oil & Refining Company in the Hilbig field, Texas; by The Carter Oil Company et al in the South Burbank and Keokuk Falls fields; by Continental Oil Company et al in the South Billings field; by Continental Oil Company in the Tepetate field, Louisiana[28]; and by groups of operators in the K-M-A field, Texas, as well as in various other fields.

Perhaps the most important instance in which data have been made available was that at Sugarland[29] where operations were carried on until November, 1941, without any interruption after the work was fully under way in April, 1930, except for a few months suspension in 1938.[28] During this period, 25,184,000 barrels of oil were produced, output gas amounted to 8,468,000,000 cubic feet, averaging 336 cubic feet per barrel; input gas amounted to 7,232,000,000 cubic feet or 287 cubic feet per barrel, and the net formation gas was 1,236,000,000 cubic feet or 49 cubic feet per barrel. Certainly the net gas-oil ratio was low, but it is difficult to say whether the results were any better than if the active natural water drive had been allowed to perform its work without aid of pressure maintenance, thereby saving considerable expense in installation and operation of the compressor plant and high-pressure lines.

It would be most interesting if the Humble Oil & Refining Company were to publish a complete and detailed

October 31st, 1942

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analysis of this work at Sugarland. Certain it is that the company has not followed this work up by large-scale projects in other fields and it is logical to assume that they would have done so had the company believed that the increased ultimate recovery, if any, would have justified the expenditure for carrying on such a project.

The effect of pressure-maintenance on ultimate recovery of oil after 15 years of operation seems to be much in doubt. On the other hand, pressure-maintenance in distillate fields appears to find many supporters and regulatory bodies have issued rules in Texas, Louisiana and Arkansas making it compulsory to return the dry gas to the producing formation to maintain the pressure as high as possible. It is assumed, at least for the present, that retrograde condensation will permit much of the distillate to condense from the gas in the reservoir which would then become unrecoverable, and thus make for a considerable loss in recovery if the pressures are allowed to decline to any considerable extent. On the face of it, this seems to be the logical conclusion, but it yet remains to be seen just how this will work out in actual practice.

Conclusions

Discussions in this article point toward the following conclusions:

1. Economics in the production of oil require greater consideration than ultimate recovery.

2. Ultimate recovery in many fields is increased by close spacing and production at maximum practicable capacity. It is possible that in nearly all oil fields this conclusion may apply, but if correct it can become evident only in the course of time.

3. Acidizing, shooting and completing wells with large casing aid in enabling wells to be produced at high capacity.

4. More energy in gas associated with the oil is available for moving oil through the sand from a given quantity of gas when expanding through a given range of lower pressures, than when expanding through a given range of high pressures.

5. Secondary-recovery methods are very important in increasing the recovery of oil where primary methods have not resulted in high percentage recovery. When primary methods have resulted in high ultimate recovery it is a question as to whether secondary methods are economically applicable.

6. Secondary methods of artificial water-flooding seem to yield higher ultimate recovery when production is at a high rate. If this is a correct conclusion, it would appear as if natural-flood with high capacity production would yield higher ultimate recovery than when production is at a low rate.

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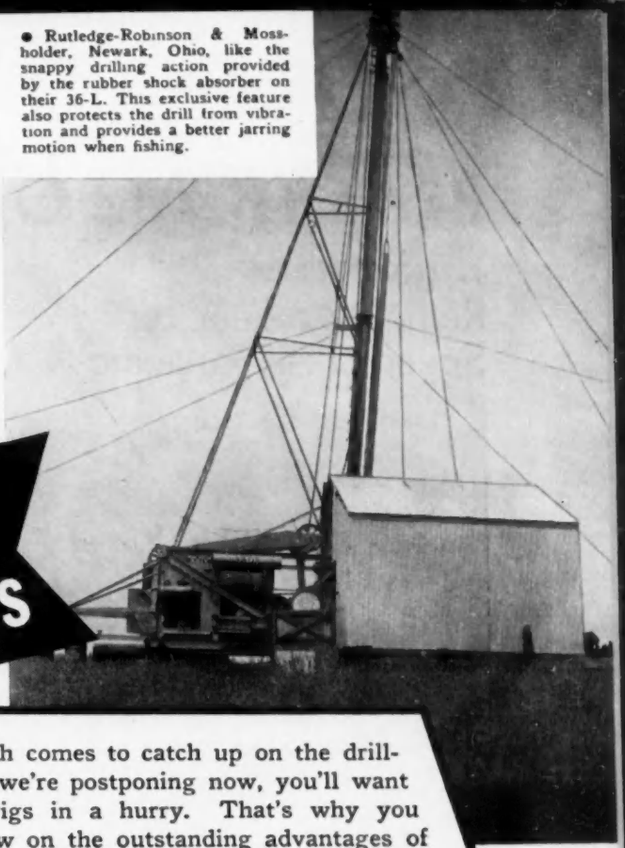

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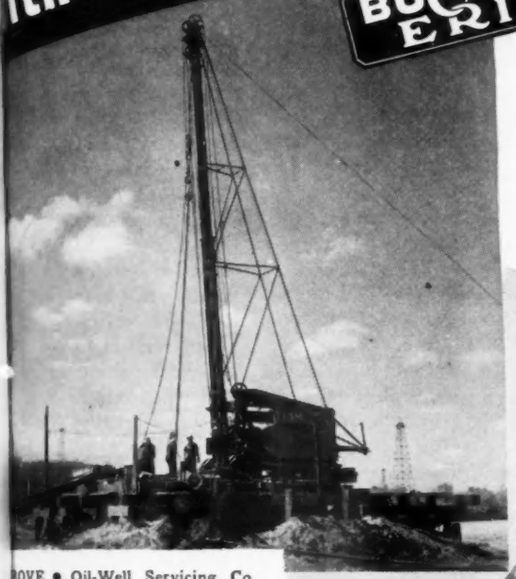

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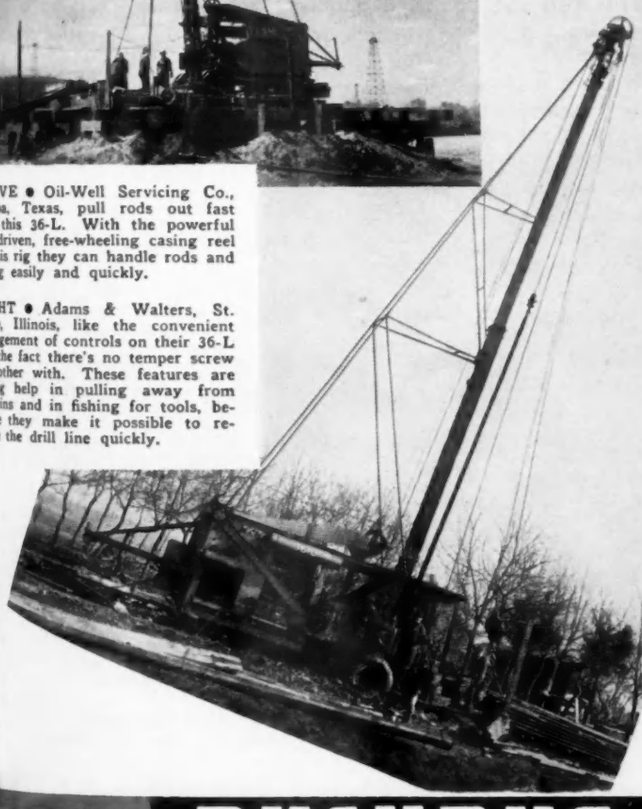

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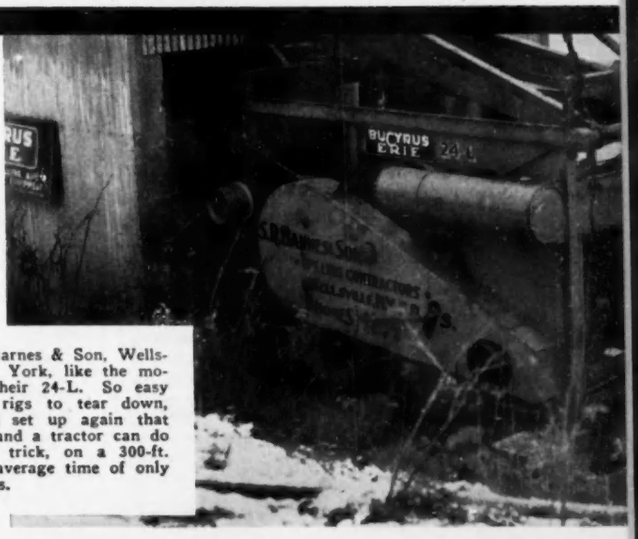

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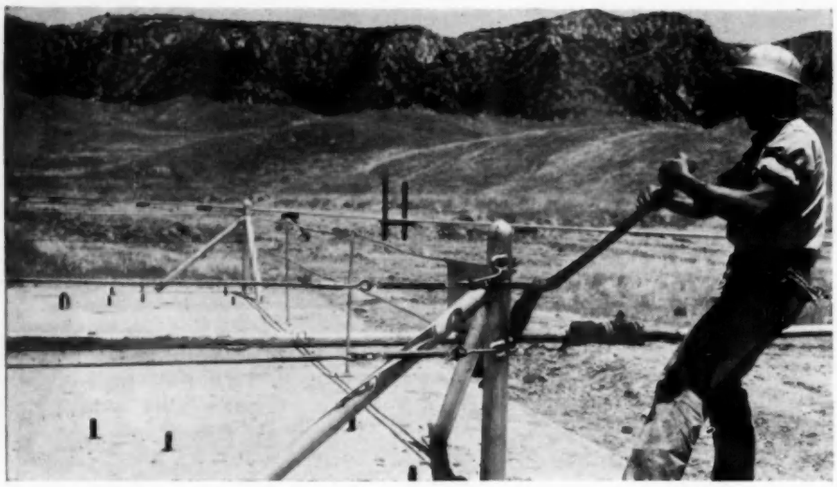


Hooks mounted on corner posts and heavy spring inserts provide means for fastening sand-line unit in place. Latching or releasing panel is through leverage gained with special tool.

A PORTABLE fence, with one or more panels removable for servicing the well, employs springs and hooks to maintain the enclosure, yet permits a breach to be made with minimum effort and without possibility of nuts or threads rusting and delaying operations.

The sand-line fence is strung in the usual manner on the sides designed to remain closed, while on the others the separate strands are carried in eyebolts, with their other ends terminating in eyes to which are attached stout helical springs.

These springs are held, by their outer, hooked ends, in loops welded to the corner posts, spring tension being sufficient to maintain taut strands and to resist ordinary efforts to dislodge.

A special tool, modeled after the usual load "boomer" of oil-field trucking, is fitted with a forked foot to rest firmly against the corner post, while the toggle end carries a hook or grab which engages in the eye of the hook on the end of the spring. By pulling against the handle the spring is extended until the supporting hook drops free of the post, a similar strain being used to bring the hook into place for manual latching when the enclosure is again to be closed.

2. LUBRICATION

Rig Front Bearings Oiled by Extension

WHEN A RIG front is employed for pumping after the well has been completed, the pumper can safely lubricate the band wheel shaft bearings if a pressure nipple is attached to the bearing cap to supplement, or replace, the oil trough packed with waste to retain and distribute the oil.

The oil hole in the bearing cap is tapped to receive any convenient bushing which reduces to the one-eighth pipe used with pressure gun fittings.

If the rig iron bearing cap comes fitted with a compression grease cup, the street ell or nipple can be screwed in the tapped hole when making the change. An extension pipe brings the gun fitting as near the walk as desired so that the pumper can lubricate the bearing without danger of injury by being caught in the band wheel.

The bearing opposite the one illustrated can be fitted likewise, with a long joint of pipe attached to the fittings so as to bring the gun nipple near the sampson post for convenience and safety.

3. TRUCKING

Truck Bumper Sheave Aids Lateral Drags

FREQUENTLY it is necessary to pull with the winch line other than in a straight line with the drum, and time is lost rigging up a snatch block to maintain proper fleet angle.

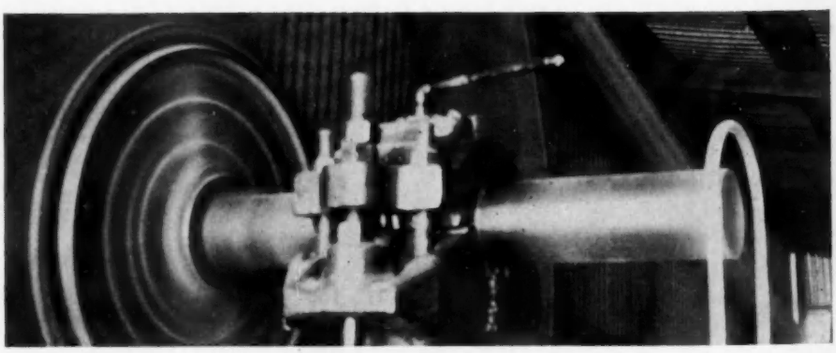
One company provides a readily available sheave for this purpose by welding two ears to the lower surface of the heavy pipe forming the rear member of the truck bed. Pivoted to these ears is a curved plate, shaped to hug the pipe and to bring the pin it carries above the truck bed when rested against the pipe.

The plate carries, as sheave, the inner race of an oversize ball bearing, mounted and rotating on the pin in the plate. This race, when the winch line is bent around it and tension applied, serves as pulley or guide for the line, facilitating winding on the winch drum.

When the line is not in use, the race serves as anchor for the hook end, the winch being run until the end is taut. Rattling of the plate is thus prevented.

THE practical operating hints for the drilling rig, production man and pipeliner, appearing regularly in these pages, are secured from oil operations everywhere and offer suggestions that will help to improve operating efficiency and safety.

The items give an excellent picture of the remarkable ingenuity being exercised by the operating divisions of the industry. Contributions to these features will be paid for at the rate of $5 for each illustrated item accepted. Address contributions to "The Editor, The Oil Weekly, Houston."



Tapping top half of bearing and bringing in pipe lead from beyond the drive pulley enables oil to be fed to unit without shut-down and with no risk or hazard to lease attendant.

THE PRODUCTION MAN

When the truck body must be left clear, as for handling heavy equipment over the rear end of the frame, the pivoted plate is dropped clear, and allowed to hang below the bed by the two supporting ears.

Due to the design of the curved plate, the hinges take practically no additional strain when a pull is applied to the winch line, the plate transferring the stress directly to the heavy truck bed end member.

Bearing race mounted on heavy pin set on curved plate fitting pipe contour serves as guide to winch line when pull is other than directly in line with winding drum. Unit drops for clearance.

4. PIPING

Hold-downs Shod for Line Wear Protection

HIGH pressure input lines of injection wells often are subjected to a constant throbbing caused by compressor impulses. An efficient, inexpensive way to dampen such vibration without danger of injuring the pipe itself or installing elaborate equipment is to use a collar clamp arrangement mounted on a concrete block, similar to that illustrated in the photograph.

The clamp consists of two pieces, one, a semi-circular light steel plate sheath curved over the pipe, and the other, an outer clamp bolted to the concrete base and which contains three large setscrews. After the outer piece is bolted securely to the base, the setscrews may be cinched up against the light protection plate, which in turn snubs down the gas line.

Chafing shoes welded to pipe take bearing of set screws and prevent scoring of pipe metal, while heavy plates bolted to massive concrete bases afford anchorage against vibration and shift.

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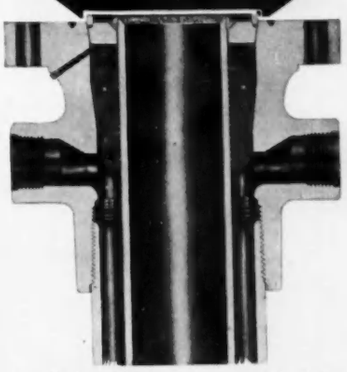

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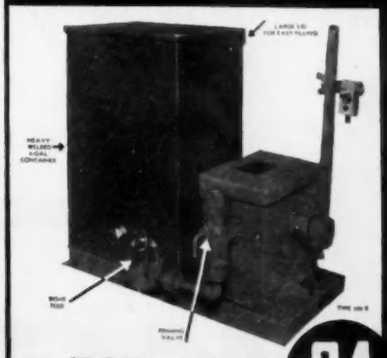

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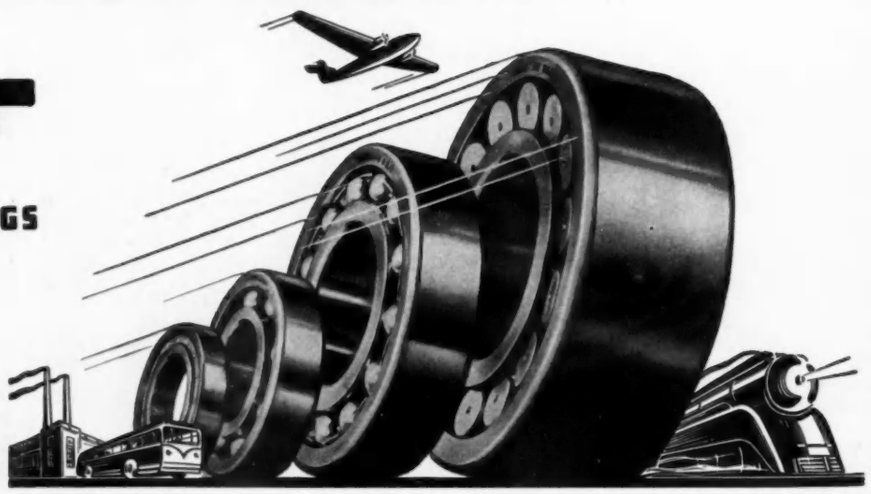

The Week's News

Work on Plan to Close in East Texas Water Wells

The Texas Railroad Commission last week failed to receive sufficient evidence of an engineering character to fix an order governing the salt-water problem in the East Texas field. As a result the commission recessed its hearing until November 19, when the engineering evidence will be presented.

Meanwhile, the commission requested that a meeting of operators' engineers and commission engineers be held at Kilgore November 4. The primary purpose of this meeting is to consider all engineering information which is affected by the order proposed, which would close in wells producing 100 barrels, or more, of salt water daily. At the hearing Commissioner Olin Culberson said that there were 1241 wells in the East Texas field which produced 347,225 barrels of salt water daily, all produce more than 100 barrels of water, but all together they produce only 19,940 barrels of oil.

The plan before the commission provides for closing in these wells and transferring their allowables to other wells on the same lease, or to other wells on leases in the better part of the field, where the oil could be produced without salt-water production.

The procedure has been pushed by the Office of Petroleum Coordinator for War who had five representatives at the hearing last week. The purpose of the coordinator is to increase the production from the East Texas field by January 1, in order that plenty of crude may be available to supply the big-inch pipe line to the north.

A proposed order offered by Joe Zeppa at the last statewide hearing was protested by Fred Weeks of Tyler, representing west-side operators. Weeks proposed several amendments, all of which were acceptable to Zeppa and the group he represents.

Primarily, Weeks thought that more than 18 months should be allowed for depletion for wells which were closed in. He recommended a maximum of 30 months, or a time determined by a decline curve plotted on the probable life of the well. Weeks also wanted to include non-marginal wells, provided they produced 100 barrels of water.

There are several legal problems to be worked out but attorneys for the operators felt that the inducements offered were sufficient to eliminate most of the litigation.

Representatives of Humble Oil & Refining Company, Shell Oil Company and Magnolia Petroleum Company indicated their companies would aid in the development of the program and assist in the transfer of allowables to some of their leases.

Gulf Oil Corporation, however, objected to any program which involved the transfer of allowables from one lease to another. Sinclair Prairie Oil Company declined to approve the plan because it feared that drainage of west-edge leases would be greater if withdrawals in the center or the east part of the field were increased.

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Well Contractors to Meet At Tulsa, November 19-20

The second anual meeting of American Association of Oilwell Drilling Contractors, to be held in Tulsa, Oklahoma, November 19 and 20, at the Mayo Hotel, has been planned to give greatest attention to current problems now confronting the drilling industry. The program Thursday morning will be given over to various committee meetings, with special emphasis on ODT, WPB, and OPC and Department of Labor problems. The afternoon session will be devoted to committee reports and an open session, and at least one paper on a pressing governmental problem.

A feature of the annual banquet will be a talk by an OPC speaker, probably on priorities. Elmo Thompson, Superior Oil Corporation, Tulsa, will be toastmaster. J. E. Brantly, association president, will address the meeting Friday morning, to be followed by Gus C. Street, Jr., Dallas, who will talk on "Wages and Hours." An address on "Manpower and Selective Service," by a selected Army speaker, and a paper on "Cooperation Among Drilling Contractors," by Howard P. Holmes, will complete this session.

Friday afternoon, Congressman Wesley E. Disney will deliver the principal address on various national problems. This meeting will also be featured by a paper on "Making the Most of What We Have," by J. S. Montgomery, general superintendent, northern region, Phillips Petroleum Company, Bartlesville, Oklahoma.

This meeting will be held before gasoline rationing becomes effective, an advantage to drilling contractors living near by who wish to drive.

Texas November Allowable 1,413,512 Barrels Daily

The Texas Railroad Commission's statewide order for November provides 21 producing days for most fields, bringing about an estimated average net daily allowable of 1,413,512 barrels.

Several adjustments were to be effected by the order, especially to equalize production between fields in Southwest Texas producing Mirando-grade crude.

Most of the fields will be allowed to produce for 21 days. The commission for the first time failed to specify the days operators should produce which will permit them to select their own producing days.

The order provides also that as much as 10 percent excess may be produced from any one well in a day. Lease production must be balanced at the end of the month, instead of the end of each week as provided heretofore. The excess allowance has been 5 percent up to this time.

In order to adjust production, several schedules of shutdown days were provided. These are set out below:

Twenty-seven producing days: West Ranch, Lovell's Lake, Amelia, Sugarland, Clear Lake and Webster; Orange Grove and Hoffman; Antelope (Mississippi Lime), Bonita, Chapman-McFarlin, Clingingsmith, Fargo, Hapgood, Hoefle, Kadane, Kadane Shallow, Mankins, Mueller, Ringgold, Sanders, Scotland, Scotland (Mississippi Lime), Walnut Bend, and Wilson and Forestburg.

Twenty-six producing days: East White Point.

Twenty-five producing days: Hawkins.

Twenty-four producing days: Wasson.

Nineteen producing days: Sand Hills (Ordovician, North Cowden, and Foster).

Twenty-three producing days: Panhandle.

Seventeen producing days: Goldsmith.

Fifteen producing days: South Cowden, Dune, Keystone (lime), Means, Penwell, Waddell, and North Ward.

The commission has announced that its next statewide proration hearing will be held in Austin on November 19.

Geologists Meet Next At Fort Worth in April

The American Association of Petroleum Geologists has scheduled its next annual meeting to be held in Fort Worth on April 7, 8 and 9, according to F. L. Aurin, president. Officers of the Society of Exploration Geophysicists and the Society of Economic Paleontologists and Mineralogists have authorized simultaneous convention dates as customary in the past. The 1943 sessions will be devoted to business of the organization and matters pertaining to the war effort, according to Aurin, and no entertainment of any character will be provided.

such tests. Even this procedure has its difficulties inasmuch as it is only possible to run one flooding test on each sample, with each sample being somewhat different in character from all of the other samples. However, this disadvantage can be overcome to a large degree by the use of a large number of samples.

During the past few years, hundreds of flooding tests using fresh core samples have been run. The cores were mounted in flood pots, which are so constructed that the flow occurs from the outside to the center of the core, with the flooded oil and water dropping from the bottom of the pot into a graduated burette with syphon tube that was previously filled with water.

From these studies the following conclusions have been made:

1. For any given oil saturation there is a critical maximum velocity above which the recovery efficiency falls off rapidly.
2. When this critical velocity is exceeded, the water/oil ratio rises extremely fast and thus shortens the economic life of the flood, and in turn reduces the ultimate oil recovery.
3. The critical velocity of a sand varies with the percent oil saturation, with sands of higher oil saturation having higher critical velocities. For example, at a given velocity the flooding action in a sand with 50 percent oil saturation will be 100 percent efficient, while for a sand with only 30 percent oil saturation the flooding efficiency may be reduced to 25 percent. These relationships observed in the laboratory have been verified by field data.
4. Recovery efficiency by flooding is largely dependent upon two factors, namely: percent oil saturation at the beginning of the flood, and the velocity of the flooding water.
5. Several of the early flood failures in the Mid-Continent area can be traced directly to low oil saturations of only 30 percent and to too high water injection rates. In a few cases where low injection rates have been used, better results have been obtained. While it is mechanically possible to reduce a 30 percent saturation to 20 percent, usually it is not economically feasible. The practical result then is that a 40 percent saturation can be reduced to a lower residual by water flooding than can a 30 percent saturation. This again ties in with the great variation of flooding efficiency with respect to oil saturation and velocity.
6. It appears that the proper field injection rate for a 330 x 330- or 440 x 440-foot spacing lies somewhere between 1 barrel per foot of sand per day, for a low oil saturation such as 30 percent, and 5 barrels per foot of sand per day for a high saturation such as 45 to 50 percent.
7. More field data are now needed in order to determine a closer working relationship between water injection rates, percent oil saturation, and flooding efficiency.

Reservoir Analysis and Geologic Structure

By J. M. BUGBEE, Baroid Sales Division, National Lead Company

Implicit in reservoir studies is the fact that oil must be displaced from the reservoir rock by some other fluid, either gas or water, and this understanding yields the terms descriptive of the major reservoir production mechanisms, gas expansion and water drive. Recent papers make clear the economic and conservation preeminence of water drive as a production mechanism.

Water drive may result either from the expansion of edge water, the reservoir water bordering an oil pool, or from the artesian flow of edge water from the outcrop. Thus, the extent of the reservoir has an important bearing upon both the rate and the ultimate quantity of water influx to an oil pool.

Lens-type reservoirs are generally recognizable, but the complete structure of the more important domal types, having possible limitations from crestal and synclinal faulting, is not well understood. The delineation from cores, electrical logs and exploitation phenomena of the crestal portions of reservoirs is increasingly exact. This paper suggests that inference from these factual pictures, combined with the scattered well and geophysical data of the synclines and with consideration of the dynamics of structural formation, may be applied to solving the complete geologic structure. Since faulting on the domes and in the synclines may effectively seal and thus limit the size of a reservoir and bar additional water influx, consideration of geologic structure and its possible effects is essential to complete analysis and prediction of reservoir performance.

Asphaltic Substances in Crude Oils

By G. W. PRECKSHOT, Standard Oil Company of California, and N. G. DeLISLE, C. E. COTTRELL, and D. L. KATZ, all of University of Michigan.

This paper presented the progress made by using the electron microscope as a new tool and by observing the effects of the streaming potential on the formation of bitumen particles, for the purpose of studying the mechanism of such precipitation. The results bring out a new phenomenon, which may occur when crude oil flows through the porous oil reservoir.

Studies of the effect of temperature and pressure on the precipitation and solution of asphaltic substances in crude oils indicated that the problem was more closely related to surface or colloidal chemistry than to the usual phase equilibria. In colloidal systems, boundary conditions produce a charge on a particle. Electro-deposition experiments removed bitumen particles from Greeley (California) crude oil that originally did not contain particles larger than 0.01 micron in diameter. Streaming-potential experiments demonstrated that crude oil flowing through sand produces a potential. This electrical potential appears to be responsible for the formation of the asphaltic particles found in crude oil that has passed through sand. Parallel phenomena are likely to occur when crude oil flows through a porous reservoir rock.

Some Properties of Bentonite Mixtures And the Effect of Thinning Agents

By WALTER F. ROGERS, Gulf Oil Corporation

Since the concentration of bentonite primarily controls the fluid viscosity and thixotropic value a study of the effects of thinning agents on drilling fluids becomes primarily a study of these materials on bentonite. For this reason, and to enable duplication of test results, predetermined bentonite mixtures were made up rather than work with field drilling fluids of chance composition.

The study involved preparation of an aqueous mixture of bentonite plus an addition agent followed by the determination of the driving weight r.p.m. curve and the fluid pH. A specially prepared gang stirrer was used to handle six samples at a time. Stormer viscometer readings at 600 r.p.m. were taken from a calibration chart of the instruments, hydrogen ion measurements with a glass electrode type instrument.

It was felt that a study of the slopes and intercepts of the straight-line curves obtained by plotting r.p.m. against driving weight would lead to information of value for the systems studied.

Hydration of the bentonite was observed through a series of tests to determine the time for the bentonite to reach its maximum viscosity with and without stirring. By checking like samples when stirred regularly for 2 hours per day against those allowed to stand for 24, 48 and 192 hours shows a pH variation between 9.10-9.55 for the stirred samples, a value of 9.40 for the unstirred. The unstirred samples show the effect of thixotrophy. Had the samples been sheared on the high speed stirred and the thixotrophy above this shear force been destroyed, they would have shown comparable slope values with the stirred samples.

Tests were made to determine the effect of bentonite concentration on viscosity. Large viscosity increases resulting from relatively minor increases in bentonite concentrate demonstrate the importance of thinners. One of the materials most actively influencing the viscosity and thixotrophy of bentonite is sodium chloride. Tests were therefore run using this thinner. Other thinners tested were sodium acid phosphate, sodium hexametaphosphate, sodium tetraphosphate, sodium pyrophosphate, and tannins.

Discussing the results, the author points out that the measurements are explained on the basis that bentonite mixtures develop high viscosity effects through the action of Brownian movement jamming the particles, which have length and breadth considerably in excess of thickness, into a brush-heap structure. The strength of this structure is proportional to the size of the hydrated particle, the number of particles and the strength of the Brownian movement.

The effect of thinning agencies is to reduce the ability of the mixture to form structure of the brush-heap type. This effect is most pronounced at high pH values and decreases with increasing hydrogen ion concentration. Thinning agents containing sodium may help to keep the bentonite particles separate. The tannin thinner was most effective for calcium and cement bentonite mixtures at high pH values but was more readily displaced from the bentonite particle with increasing acidity of the mixture.

Gravitational Drainage of Liquids From Unconsolidated Wilcox Sand

By ROSCOE F. STAHL, Pan American Refining Company, and R. L. HUNTINGTON, University of Oklahoma

In certain volumetric oil fields the performance of the reservoir during the latter part of its producing life is governed to a large extent by the downward movement of liquid due to the force of gravity. This is especially true of formations having thick or tilting beds of uniformly high permeability, free of shale breaks. Previous investigators have pointed out the importance of such studies in the estimation of

future reserves as well as the original fluid content of a reservoir, but have not reported data showing the history of saturation distributions during the drainage period. This latter knowledge is helpful in obtaining crude oil from such a reservoir, and such data have been obtained by experimental investigations.

Drainage tests were carried out in two vertical tubes eight feet in height packed with a Wilcox sand from an outcrop near Ada, Oklahoma. To collect data on production and rate of drainage a cock at the bottom of the tube was opened at regular intervals. As might be expected, the depletion was found to be most rapid in the uppermost part of the tube where no influx of crude oil replaces the part of the liquid drained out. Depletion rate though rapid at first at the top of the tube, flattened off toward the later stages of drainages.

Response of a Gulf Coast Drilling Mud to Chemicals, Temperature and Heat Treatment

By GEORGE FANCHER and
ROBERT L. WHITING,
University of Texas

A typical drilling mud from the Hastings field, Texas, containing only 8 percent (dry basis) of material of colloidal dimensions, which is largely illite, was concentrated to a density of 10.2 pounds per gallon and used in the study. The effects of water dilution, treatment with complex polyphosphates, temperature and the time of heating upon the reheological properties of the mud were investigated, and led to the following conclusions:

Dilution of Hastings mud results in lowering of the viscosity and gel strength and increase in the filtration rate. Sodium acid pyrophosphate and sodium tripolyphosphate are more effective than other complex polyphosphates in reduction of the viscosity of Hastings mud containing illite. The number of mols of polyphosphate required for reduction to minimum viscosity is independent of the polyphosphate used. Hastings mud treated with either sodium acid pyrophosphate or sodium tripolyphosphate exhibits fewer characteristics of overtreatment.

Hastings mud treated with either sodium hexametaphosphate or tetrasodium phosphate has lower filtration rates than mud treated with other complex polyphosphates. Filtration rates for Hastings mud treated with either sodium acid pyrophosphate or sodium tripolyphosphate become nearly constant at high concentration. When Hastings mud is treated with a polyphosphate, usually minimum filtration rate is obtained at the point of minimum viscosity.

The variation of the viscosity of a mud with temperature is believed to depend upon the relative magnitude of (a) The viscosity-temperature variation of water. (b) The effect of temperature on the dispersed phase clay of the mud. The latter depends on the length of time the mud is held at an elevated temperature. The temperature at which viscosity of a mud is minimum varies inversely as the solids to water ratio. The changes brought about in a mud which result in changes in rheological properties upon heating are permanent and depend upon the time of heating until a maximum change results. Maximum viscosity was obtained in from seven to ten hours of heating. Heating of chemically treated muds results in impairment of the rheological properties except in the cases of sodium acid pyrophosphate and sodium tripolyphosphate which are only slightly affected.

Sodium acid pyrophosphate and sodium tripolyphosphate were found to be more efficient than other polyphosphates for treating Hastings mud from all points of view. Hastings mud was found to be very stable. When completely hydrated, no changes in rheological properties were found over a period of six months. Ammonium polyphosphates are believed to be unsatisfactory in mud control practice on the basis of the two compounds studied. Neither compound possessed good viscosity reduction properties and each overtreated greatly at low concentration.

The Effects of Certain Gums and Starches on Filtration of Salt-Water Muds at Elevated Temperatures

By FRANK PERKINS and
BENJAMIN C. CRAFT,
Louisiana State University

It has been found that of the many factors which have an adverse effect on filtration, the presence of electrolytes in general and salt in particular is outstanding. The effect is one of flocculation of the colloids due to neutralization of the negative charges on the clay particles. This reaction is further increased in the Gulf Coast as high temperatures reduce dispersion to a minimum, causing increased flocculation in both fresh and salt-water muds.

A laboratory study was made of the chemical available for improving the filtration characteristics of salt water muds at high temperatures, and the use of germicides to prevent fermentation.

The study on effect of temperature showed a filtration loss at 75° F. of 55 c.c. on untreated salt water as compared with a loss of 8.7 c.c. when the same mud was mixed with fresh water. The filter cake thickness for the salt water mud was one half inch. While gum ghatti was rather diffcult to disperse, it was found somewhat more effective and stable than the commercially prepared starch and gelatinized starches, and showed a marked improvement over gum karaya. The increasing effectiveness of the two starches above 175° F. suggests that elevated temperatures increase their protective or coating power and consequently decrease the effect of salt. The gum-treated samples had a better filter-cake texture than those treated with starch. In each case the cake thickness was directly proportional to the water loss.

Concentrations of commercially prepared starch above 1.5 percent caused a marked increase in viscosity, emphasizing the importance of careful control at the well. The increasing effectiveness of even a small concentration at high temperatures was well illustrated.

Fermentation tests showed that gelatinized starch did not ferment in the laboratory or upon the addition of surface soil; however, it is believed that under well conditions bacterial action would take place. Gum karaya and gum ghatti showed slight fermentation upon addition of surface soil, and the commercial prepared starch showed a marked tendency to ferment under all conditions. Fermentation in each case was readily prevented by the addition of one half percent by weight of commercial germicides, such as the sodium salt of trichlorophenol and pentachlorophenol.

Conclusions from the tests are that gelatinized starch, commercially prepared starch and gum ghatti are very effective reducers of filtration loss at high temperatures. Gum ghatti while rather difficult to disperse is the most stable and effective. Commercially prepared starch is recommended for general field use as it is not adversely affected by temperature and is readily available at a reasonable cost, whereas the gums are not available in large quantities due to the present world situation. A germicide should be used with all treatments to prevent fermentation.

Surface Energy Relationship In Petroleum Reservoirs

By H. K. LIVINGSTON,
University of Chicago

A technique has been developed which makes it possible to determine the spreading pressure of liquids and solids, for simple systems. The results can be applied to the evaluation of capillary rise and displacement pressure in a petroleum reservoir.

From available data it is possible to reach certain conclusions that apply directly to problems of petroleum production. Some of these are as follows:

That displacement pressures of water for oil in actual reservoirs probably is in the neighborhood of 5 pounds per square inch in a capillary of one micron radius.

The height to which water will rise into an oil sand will depend on the oil water interfacial tension, contact angle and radius of curvature of the capillaries in the sand. There is no accepted method of determining the radius of curvature of rock pores. However, an approximate method of solving the height of capillary rise of water in a sand was presented.

The surface energy relationships are directly applicable only to static phenomena such as capillary rise and displacement pressure. However, it has been observed that changes in these relationships may cause marked changes in rates of flow.

Surface active agents that decrease oil-water interfacial tension act to decrease capillary rise, and thus decrease the amount of water in an oil sand and also to decrease the displacement pressure and consequently presumably reduce the efficiency with which oil is removed from the reservoir.

Desirable Features of Non-Thixotropic Drilling Muds

By ELDON A. MEANS,
Eldon Means Laboratories

That drilling muds should be thixotropic has been a tacit assumption in most discussions of this subject. Laboratory observations of drilling muds from Kansas, Oklahoma, West Texas and New Mexico show many of these native muds to be non-thixotropic. With these muds the character of the cuttings remained the same as with thixotropic muds, even though the viscosity was lower. That, for a filtrate loss generally considered bad, the ability of the driller to go into and come out of the hole was much better. There apparently was less caving of shale, in spite of serious water loss. Again, non-thixotropic materials exhibit considerable ability to stand salt water.

Determination of the various properties of such non-thixotropic muds, such as particle size, distribution, hydration

and plasticity would throw light on the observed properties of such mud. This paper is to study such properties in relation to field performance.

Non-thixotropic mud up to 5 percent in suspension usually settles relatively rapidly. In practical drilling there is a considerable amount of mud which has gone into suspension from normal drill operation. It is into this material that additive muds are entered. Under these conditions there is no difficulty keeping non-thixotropic material in suspension.

The ability of clays of all kinds to increase specific gravity is dependent upon the specific gravity of that particular clay and, since there is very little specific gravity difference in various clays, this property goes as expected with non-thixotropic materials. However, it is pointed out that inert weighting materials need smaller particles to make them less liable to leakage and more plastic.

The paper demonstrates that if it were possible to control and choose the factors of particle size and hydration, much could be done to give drilling fluids the desired properties. When materials are available with known particle size and hydration it should be possible to construct a drilling fluid by beginning with the fluid which is already in the hole.

In concluding, the author observes that some of the objectives of the research have been realized for non-thixotropic drilling muds, namely a relation between particle size and leakage, angle or repose, plasticity and extrusion pressure. Methods for producing clays having known properties as to particle size and hydration have been applied to drilling muds and the results noted.

A Reservoir and Well Behavior Analyzer

By W. A. BRUCE,
The Carter Oil Company

The paper covers the theory and present state of development of an apparatus for the non-mathematical analysis of complex reservoir and well-behavior problems. As now developed the apparatus is capable of solving the water drive part of any reservoir drive problem for which a mathematical solution has been presented either on the basis of steady or unsteady state flow analysis. The theory is presented for the extension of the scope of this analyzer to the point where it should be able to solve reservoir performance problems previously thought too difficult for practical solution by mathematical means.

In this method the porous continuum of the reservoir is assumed to be divided into small blocks or units, each small enough so that a material balance on the fluids within the block can be used. To analyze reservoir behavior from this point of view mathematically, there would result a set of simultaneous difference equations (two for each block) which must be solved or combined into a partial differential equation. In the method described, instead of solving the sets of equations analytically, electrical units are constructed which will behave in respect to the flow of electricity exactly as the reservoir units behave under various conditions of fluid flow. The electrical units are then wired together in the same way that the reservoir units are naturally connected by virtue of their geometrical locations and shapes.

The author develops mathematically the analogy between fluid flow equations and the electrical flow, taking as special cases water-drive and gas-flow units, and showing how the analogy applies in case of the gas-cap problem.

By means of an analysis of the Dix Pool, Jefferson County, Illinois, on which fairly complete data are available through the drilling program and production figures, a pool unit is developed and the electrical simulation of reservoir action laid out, balanced to agree with field data, and then with a predetermined time and quantity scale, the electrical model has put through it a series of current flows as switches are thrown to simulate well drilling, resistors being adjusted to maintain actual production flow proportions.

Data through December, 1939, were put into the analyzer, the resulting pressures as indicated by the apparatus being 15 percent below actual field readings. Adjustments for water-drive unit and pool unit were made until analyzer voltages seemed best to agree with observed pressures as far as the run was carried.

The synthesis of further pressure data beyond December, 1939, was continued and the results obtained agreed closely with observed pressures at each time interval. Once the resistances were set by the history of the pool up to 1940, no further changes were made to carry the synthesis into 2½ more years of development.

Electric Exploration for Oil

By H. M. EVJEN, The Elflex Company

An electrical method of geophysical exploration has recently been developed. This brief account of the method will attempt to explain only the most fundamental and most essential principles of the method. A few field experiments to illustrate some of the principles are cited.

The basic principle of the method depends on the fact that, when an alternating current is sent into the ground, its penetration depends upon its frequency of alternation. The author shows that the current will try to crowd nearer to the surface when frequency is increased, and bases his method upon this phenomenon.

In broad outline, the instrument measures a potential picked up from the ground. By a potentiometer arrangement, it measures this potential directly as a fraction of the total energizing current flowing into the ground. The observed quantity therefore has the dimensions of an impedance. The current is commutated at a rate which can be very accurately controlled. The potential is picked up and commutated in synchronism with the current. The greatest care must be exercised in keeping the phase-relations here involved absolutely constant, and a special commutator has been designed for this purpose.

After describing a few critical experiments, the author offers the conclusion that the experiments must be admitted to have more of a negative than a positive value. They show that the results obtained do not originate in the apparatus, nor can they be caused in any conceivable manner by shallow features. It is true that the results do not disagree with simple, undisputable fundamental theory, according to which measurable and definite results should be obtained, under the proper conditions, from considerable depth.

Many experimental arrangements are possible by which positive proof of depth can be obtained. All such arrangements known and tried by the writer, however, involve a considerable amount of experimental work. The data from several thousand stations, which the writer does possess and which in his opinion furnish the desired proof, are not available for obvious reasons.

It is unfortunate that a truly satisfactory positive proof necessarily must be of a statistical nature. Our knowledge of the subsurface, which necessarily enters into such a proof, is itself statistical. It is an easily recognized fact that seemingly unsatisfactory results at any one station, or even at a limited number of stations, do not necessarily condemn a method, no matter how much time is spent at this or these stations. Similarly, seemingly satisfactory results from a relatively small number of stations prove nothing when looking for an experimental proof.

If we have sufficient confidence in theoretical predictions, less experimental work may be required to verify or disprove these, but a detailed theory is complex and involves many unknown quantities. Therefore, so-called "crucial" experiments are difficult to find.

In any event, the practical man is not satisfied with theory but demands cold facts. In the present case these facts, as stated, are not available for publication. It may be shown, however, how the method works in practice.

The Role of Capillarity in Oil Production

By G. L. HASSLER, E. BRUNNER and T. J. DEAHL, Shell Development Company

In this paper the authors intended that the pressure difference developed in rock capillarity be examined, defined, and given some engineering use in terms of some new measurements that have been made. Such pressure differences, namely, the capillary pressure, the displacement pressure and the threshold pressure, seem to provide a proper contact between the basic molecular quantities and the old field.

The most important pressure difference function is the capillary pressure, a function of saturation which expresses the pressure difference between the interconnected phases in a rock. Since capillary pressure measurements upon rock have not been available, these new measurements are presented to facilitate discussion.

The authors compare the theoretical cylindrical capillary tube with one formed by the contact of three spheres, this concave triangular capillary being more readily visualized than the former tubular unit.

A somewhat closer approximation to well sorted, well rounded sandstone is furnished by the interstices within a roughly triangular tube of orthorhombic packing of uniform spheres. At the narrowest part of such a packing the concave triangular tube is represented correctly, as to relation between water content and surface curvature.

Utilizing the concepts thus outlined, displacement pressure measurement of the wetting preference of porous materials may be examined. Utilizing a porous material, carefully sized, when two immiscible fluids form a surface of contact with that porous material a reproducible pressure exists across the

surface of contact, this being termed the displacement pressure because it occurs during the displacement of one fluid by the other.

Data are presented giving the capillary pressure-saturation relations for representative sandstones and dolomites, for both two-phase and three-phase conditions. A visualization of capillary forces in terms of round tubes is criticized, and a recommended alternative visualization in terms of capillary tubes of concave triangular section is recommended. Improved definitions of capillary pressure, threshold pressure and displacement pressure are presented. The concept of capillary hysteresis is widened to include "trap" as well as previously accepted "optional" hysteresis and these new terms are defined.

The various occurrences of the displacement pressure phenomenon as a maximum threshold pressure, as a minimum capillary pressure and in the Bartell cell are discussed. The theory of capillary flow at the outlet boundary is developed to reveal the occurrence there of a pressure discontinuity in the nonwetting phase equal in value to the capillary pressure at critical saturation.

An outline of the subject of capillarity from the point of view of exploitation engineering is presented, with brief mention of the special problems of oil accumulation, the equilibrium vertical distribution of oil, and multi-layer flow.

Mud Acid—Its Theory and Application to Oil and Gas Wells

By PHIL J. LEHNHARD,
Dowell, Incorporated

Several years ago mud acid was first introduced in the Texas and Louisiana Gulf Coast oil fields, and since that time has been used in increasing quantities. The actual mechanics of increasing the production of wells producing from a sand formation is very different from that involved in wells producing from limestone formations, even though both require the solution of certain parts of the formation by chemical means. In limestone formations, the material which is dissolved by acid treating is principally calcium carbonate; whereas in sand formations the material dissolved with mud acid is principally clay and bentonitic materials. Mud acid is a mixture of hydrochloric acid and certain other chemicals added to give it the proper demulsifying and surface tension characteristics.

Studies on the effects of mud acid show that large increases in the productivity of sand wells are due to the reduction or elimination of abnormally high pressure drops near the bore hole of the well; and that only small increases in productivity may be obtained in most instances unless such abnormal pressure drops occur. Some oil sands contain clay or bentonitic material which has the ability to hydrate or swell when in contact with water and hydration of such materials in the sand cause a reduction in its permeability.

At present it is not possible to accurately predict whether a particular sand well will or will not respond to mud acid treatment. However, it may be determined if conditions favorable to an increase exist, or that there is no chance for increasing the production of some wells.

Besides increasing the current production of wells, there are other ways in which mud acid can be of benefit, including: (1) Reduction in lifting costs by increasing or prolonging the flowing life; (2) Increasing ultimate economic recovery in gas-drive fields, or one under volumetric control, due to decreasing the pressure drop or energy loss necessary to move the oil into the well; (3) Increased productivity from a selected portion of the producing zone enables an operator, in the case of a water-drive field, to perforate a smaller and higher section, delaying water production while obtaining the same rate of oil output; (4) In the case of an expanding gas cap the same benefit illustrated in the case of a water-drive field may be obtained, because mud acid would allow the operator to perforate a smaller section, farther below the gas, and thus delay the time when the well would have an excessive gas/oil ratio.

Scope and Content of Specialized Courses In Petroleum Engineering

By HARRY H. POWER,
University of Texas

A vital need exists for discussion of college specialized curricula in petroleum engineering. Although considerable improvement has been made in recent years by several institutions, an effort to correlate efforts should result in a more unified front and less misunderstanding on the part of educators and industry alike concerning undergraduate preparation for an engineering career.

The broader aspects of the petroleum-engineering curriculum have been covered from various viewpoints in the past. The specialized courses should be discussed minutely by petroleum-engineering educators in group sessions organized solely for that purpose and not casually, or as a side issue to some other branch of engineering. In the past it has been observed that our own issues were more or less neglected because of the press of matters considered by associated but wholly self-centered groups. Although standardization of courses is not recommended, yet some underlying basis for comparison should enable a 30-year old branch of engineering to stand more squarely on its own feet and make apologies to no one.

The Effect of Casing Perforations on Well Productivity

By MORRIS MUSKAT,
Gulf Research and Development Company

Analytical calculations have been carried out on the effect of casing perforations on the productivity of wells, and formulas have been derived for general types of perforation patterns.

The study showed that the effect of the perforations may become significant for perforation spacings of the magnitude commonly used in practice. Thus, even for an eight-line pattern of ¼-inch perforations in a 3-inch radius hole, the productivity of the well would be cut to 70 percent of that of an open hole if the spacing along the lines were as great as 16 inches.

But as to be expected, the effect of the perforations in reducing the productivity of the well decreases as the number of lines around the circumference increases, provided the spacing in each line remains fixed. It also decreases as the perforation radius increases. The perforation pattern represents a relatively greater part of the resistance to flow in the composite sand and casing system for the wells with larger casing than for those with smaller casing, and hence is of less importance in the latter.

A coplaner or non-spiral perforation pattern has, for all practical purposes, exactly the same effect on the well productivity as the spiral perforation pattern. It is essentially the total number of perforations over a given sand thickness that determines the reduction in well productivity, rather than the details of the distribution. There is a tapering off of the rate of rise of relative productive capacity with perforation density as the latter increases. Thus, for example, for a density of three perforations per foot of casing, the well productivity will be cut to one third of that of the uncased well for a perforation radius of ⅛-inch, and to approximately one half for a perforation radius of ¼-inch regardless of the detailed manner in which the perforations are distributed over the casing surface. The reduction in productivity due to slotted liners is relatively small.

Analysis of Reservoir Performance

By R. E. OLD, JR.,
Core Laboratories, Inc.

Through the use of pressure and production records, formation properties and bottom-hole sample data, the performance of an oil reservoir may be studied analytically to define and evaluate the natural forces acting on and within the reservoir.

Quantitative methods were presented that are applicable for identification and determination of magnitude of water encroachment, determination of initial oil in place, and calculation of pressure behavior in oil reservoirs. The methods were illustrated in study of the Jones sand in the Schuler field.

It is apparent from this and similar studies that the use of material-balance and water-drive equations when properly applied to field data gives a fundamental tool for evaluation of reservoir performance. One especially important usage is in the determination of pressure behavior. Critical rates of production may be established for water-drive fields. Rates and quantities of injected water to supplement natural encroachment may be predetermined. The effect of gas injection can be known before such program is initiated. Thus the effects of various production programs can be safely evaluated beforehand. When these determinations are combined with core-analysis saturation data, the economics of recovery under each can be analyzed, and the most profitable one selected.

These calculations can be made when reservoir - pressure measurements, production record of oil, water and gas, and bottom-hole sample analyses are known. Determination of structural dimensions using porosity, connate water and permeable thickness from core analyses will aid in earlier application and increased accuracy of results.

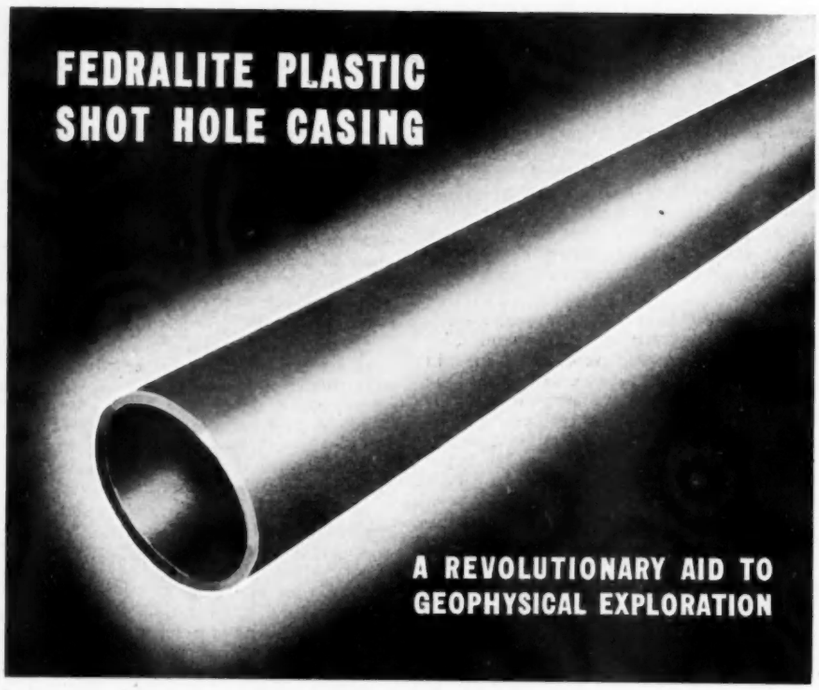
The importance of complete and accurate pressure and production records cannot be overemphasized. Reservoir pressure is affected as much by withdrawal of equal reservoir volumes of water and gas as by oil. The extra effort to measure and record these quantities is well justified in view of the increased knowledge of reservoir performance that may be gained by their use.

[*Continued from page 12*]

OPA officials pointed out that in many cases the contract price for drilling oil and gas wells is payable in cash, while in others the contractor agrees to take an interest in the well. Differences in terrain, proximity to water, fuel and supplies, depth, size of hole, number of strings of casing needed, number of cores to be taken, amount of risk assumed and many other factors enter into the fixing of the price for each individual drilling operation.

Similarly, extinguishing oil- or gas-well fires is highly specialized work and agreements on the price to be charged are usually reached after an examination of the blaze. The operation, while sometimes requiring months, may under some circumstances be concluded in only a few hours.

The exemptions granted cover all necessary operations in connection with well drilling, such as preparation of location, fishing jobs, pulling, salvaging and plugging operations.



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PRICES: An increase of 25 cents a barrel on much of the crude produced in the Lima oil field of northwestern Ohio and northeastern Indiana has been authorized by the Office of Price Administration in a move to halt premature abandonment of wells, to become effective November 2.

Under the petroleum price schedule, two prices have applied to Lima field production, $1.25 per barrel on about three fourths of the output and $1.60 per barrel on the remainder. The amendment increases the former to $1.50 but makes no change in the latter.

It was explained that studies indicated that the cost of production in the field is substantially equal to the new $1.50 maximum price, and that abandonment of wells before they are exhausted has been taking place.

Substantial quantities of the crude are being used without processing as fuel oil by industries directly engaged in war production, and loss or diminution of the supply would force the use of more expensive fuel, it was said.

☆

SPECIFICATIONS: New minimum specifications which will apply to all gasoline, kerosine, distillate and residual fuel oils delivered in the East under the "pooling" system established by Directive No. 59 were announced by OPC October 28.

As previously disclosed, the minimum gasoline specifications call for 80-octane for premium, the quality necessary to meet Army requirements, and 72-octane for regular or house brand, with no specification for third grade.

The minimum specification for kerosine has been set in accordance with the standards of the Treasury's procurement division (VV-K-211a), which applies to purchases for the Army and Navy, and Commercial Standard CS12-40, set up by the industry several years ago and adopted as the basis for all fuel-oil specifications, including those for Army and Navy purchases, will be applied to fuel oil.

OPC reassured the public that the new specifications will cause no undue hardship and, in a message to the industry, pointed out that they apply only to products imported into or produced in the Eastern States under the directive, and nothing therein shall require any change or action in conflict with any federal, state or local law, or any directive of any federal war agency "or waive any provision of any other specification not inconsistent herewith."

Gasoline Accumulates in Providing Fuel Oils

By drawing on crude stocks and stepping up crude runs to stills, there were achieved some additions to stocks of needed light and heavy fuel oils in the week ended October 24. But in providing the essential fuels, the industry made more gasoline than needed, and although stocks already were larger than justified, they were increased during the week by almost 600,000 barrels.

The week's accumulation of gas oil and distillate fuel amounted to 641,000 barrels. While that addition was welcome, it was less than desirable and even considerably less than normal for the season. In the corresponding week last year, 2,500,000 barrels of the light oils were accumulated for storage. The stocks of 47,567,000 barrels on hand October 24, 1942, were 7,379,000 barrels (13.4 percent) less than those of 54,946,000 barrels held on October 25, 1941. The week's build-up of stocks was largely in the East Coast district, although the Middle West also showed a considerable increase. California drew on stocks substantially, and the Rocky Mountain and upper Mid-Continent districts took out small quantities.

Residual fuel oil stocks were expanded 536,000 barrels in the week of October 24, with the East Coast and West Coast districts largely accounting for the increase, although the upper Mid-Continent and Rocky Mountain areas showed smaller gains The Middle West, however, took out nearly 200,000 barrels. The national inventory of 79,073,000 barrels October 24 was 15,266,000 barrels or 16 percent less than that of 94,339,000 barrels on hand October 25 last year.

The above indicated additions to fuel oil stocks in the week of October 24 were the result of an increase in daily average crude runs to stills by 67,000 barrels. Refineries processed 3,776,000 barrels daily, having operated at 78.7 percent of capacity. The runs were 295,000 barrels a day, or 7 percent, under those in the like week last year, when the average was 4,071,000 barrels.

Gasoline stocks in the United States rose from 78,956,000 to 79,545,000 barrels in the week ended October 24, an increase of 589,000 barrels. The inventory at the end of the week was 2,845,000 barrels (3.4 percent) under that of 82,390,000 barrels on hand October 25 last year. The Oklahoma-Kansas district was the only major area that drew on stocks during the week. The largest addition to storage was nearly 300,000 barrels in California.

The relatively high rate of refinery runs was possible only by continued withdrawal of crude from storage. The nation's crude stocks came down 1,003,000 barrels in the week ended October 17, the Bureau of Mines reported, in extension of earlier declines, and for the week of October 24 a further withdrawal of crude probably occurred, as runs to stills increased substantially more than daily average crude production, which was upon only 15,000 barrels. The crude output averaged 3,917,000 barrels daily. It was within 182,000 barrels or 4.4 percent of the 4,099,000 barrels per day produced in the corresponding week last year.

Markets Reflect Shortages Of Tank Cars and Crude

Markets naturally remain generally firm, under the prevailing conditions of shortage of transportation facilities and scarcity of oils themselves in the East and Middle West. However, there are some disturbing factors, particularly the clouding of the outlook by scheduled nation-wide gasoline rationing and the problems for the industry in connection with rationing of fuel oils, with suppliers waiting for issuance of fuel-oil coupons.

Mildly encouraging to oil producers generally was the action of OPA in granting an increase of 25 cents a barrel on oil produced in the Lima field of Northwest Ohio and Northeast Indiana, effective November 2, "to halt premature abandonment of the wells, and thus to insure continued supply of low-cost fuel oil produced from this crude." Independent producers in all sections of the country are agitating for higher crude prices to make it possible for

Trends of Operations and Changes in Stocks

Figures on crude stocks are from Bureau of Mines weekly reports; all others from American Petroleum Institute weekly reports, which are estimates on Bureau of Mines basis.

ITEM	Crude Oil Prod. Bbls. Day (Add 000)	Crude Oil Prod. Week Ended	Runs to Stills Bbls. Day (Add 000)	Runs to Stills Week Ended	Crude Stocks Bbls. (Add 000)	Crude Stocks Week Ended	Gasoline Stocks Bbls. (Add 000)	Gasoline Stocks Week Ended	Gas Oil & Distillate Stocks Bbls. (Add 000)	Gas Oil & Distillate Stocks Week Ended	Residual Fuel Oil Stocks Bbls. (Add 000)	Residual Fuel Oil Stocks Week Ended
Highs:												
1939	3,910	8- 5	3,650	10-21	278,607	5-26	87,769	4-22	39,562	10-28	116,237	8-26
1940	3,890	3-16	3,690	6-22	265,865	8-31	102,817	4-20	49,051	10-19	109,135	9-14
1941	4,337	11-22	[4]4,120	10-18	266,187	3-29	99,727	3-29	[5]54,983	11-15	102,448	1- 4
1942	[4]4,337	2- 7	3,961	1- 3	263,208	3-28	[1]107,229	3-14	49,357	1- 3	95,857	1- 3
Lows:												
1939	[3]1,601	8-26	3,125	2-18	[2]229,127	10-21	71,152	10- 7	20,722	4-15	105,397	4- 8
1940	3,335	11-30	3,370	1- 6	237,339	1-27	79,847	11- 9	23,551	4- 6	102,344	2-10
1941	3,364	1-11	3,490	1-18	240,399	11-15	79,923	10- 4	28,381	4-12	90,914	7-12
1942	3,297	7- 4	3,393	5-23	238,118	10-17	78,956	10-17	29,240	4-25	76,903	7- 4
Trends in 1942 (Week Ended):												
Jan. 3	4,038	.....	3,961	.....	244,440	.....	92,987	.....	49,357	.....	95,857	.....
Jan. 31	3,871	.....	3,848	.....	250,740	.....	97,810	.....	40,674	.....	91,189	.....
Feb. 28	4,016	.....	3,675	.....	259,373	.....	105,635	.....	34,547	.....	88,285	.....
Mar. 28	3,820	.....	3,667	.....	263,208	.....	105,624	.....	31,756	.....	83,045	.....
April 25	3,881	.....	3,506	.....	257,073	.....	102,897	.....	29,240	.....	81,107	.....
May 30	3,877	.....	3,522	.....	255,023	.....	95,355	.....	31,384	.....	79,628	.....
June 27	3,719	.....	3,581	.....	253,364	.....	88,396	.....	32,851	.....	77,304	.....
July 25	3,691	.....	3,658	.....	249,262	.....	82,281	.....	35,966	.....	77,816	.....
August 29	3,964	.....	3,697	.....	249,007	.....	80,831	.....	42,060	.....	78,034	.....
September 26	3,909	.....	3,802	.....	242,785	.....	80,550	.....	45,945	.....	78,943	.....
October 3	3,685	.....	3,879	.....	241,179	.....	80,361	.....	45,750	.....	79,036	.....
October 10	3,857	.....	3,766	.....	239,121	.....	79,731	.....	46,007	.....	78,681	.....
October 17	3,902	.....	3,709	.....	238,118	.....	78,956	.....	46,926	.....	78,537	.....
Oct. 24, 1942	3,917	.....	3,776	.....	.....	.....	79,545	.....	47,567	.....	79,073	.....
Oct. 25, 1941	4,099	.....	4,071	.....	[4]243,635	.....	82,390	.....	54,946	.....	94,339	.....
Change:												
In week	+45	.....	+67	.....	—1,003	.....	+589	.....	+641	.....	+536	.....
In year	—182	.....	—295	.....	—5,487	.....	—2,845	.....	—7,379	.....	—15,266	.....
In year	—4.4%	.....	—7.2%	.....	—2.2%	.....	—3.4%	.....	—13.4%	.....	—16.1%	.....

[1] All time peak. [2] Lowest since April, 1922. [3] Lowest since October, 1922, due to shutdown of six Mid-Continent States. [4] Stocks, October 18, 1941.

Petroleum Production in the United States

(Estimates compiled by The Oil Weekly. All figures indicate daily averages, in barrels)

STATE OR DISTRICT	[1]OPC Allocation in October	PRODUCTION IN WEEK ENDED Oct. 24	PRODUCTION IN WEEK ENDED Oct. 31
Arkansas	79,500	73,300	73,850
California	782,000	747,000	722,300
Long Beach	.....	34,800	34,700
Midway-Sunset	.....	55,900	55,500
Kettleman Hills	.....	38,100	39,800
Wilmington	.....	96,300	94,400
Rest of State	.....	521,900	497,900
Colorado	7,000	6,500	6,650
Illinois	280,000	264,100	265,900
Salem	.....	38,750	37,150
Louden	.....	44,600	49,850
Other New Pools	.....	169,450	167,450
Old Pools	.....	11,300	11,450
Indiana	19,000	16,500	16,900
Kansas	294,000	303,900	297,700
Kentucky	13,800	12,400	12,250
Louisiana	337,200	327,200	328,650
North	.....	97,550	97,850
South	.....	229,650	230,800
Michigan	65,700	65,750	62,900
Mississippi	50,000	69,800	69,350
Missouri	.....	130	130
Montana	24,400	22,750	22,550
Nebraska	3,500	3,300	3,400
New Mexico	101,100	100,250	120,200
New York	15,400	13,500	12,750
Ohio	11,400	9,700	9,600
Oklahoma	417,000	364,450	368,050
Oklahoma City	.....	67,400	67,800
Seminole Area	.....	87,100	87,350
Rest of State	.....	209,950	212,900
Pennsylvania	50,800	51,500	50,950
Tennessee	.....	30	30
Texas	[2]1,407,600	1,379,550	1,393,250
Upper Gulf Coast	.....	318,850	321,850
East Texas Field	.....	362,150	362,250
Rest of Eastern Texas	.....	96,800	91,050
Lower Gulf Coast	.....	98,800	98,850
Southwest Texas	.....	49,900	50,800
South Central Texas	.....	17,850	17,900
West Texas	.....	209,800	213,750
North Texas	.....	139,850	139,900
Panhandle	.....	85,550	97,900
Utah	.....	15	15
West Virginia	16,000	9,650	10,200
Wyoming	90,800	95,600	94,000
Total United States	4,066,200	3,936,875	3,920,675

[1] Production rates recommended for state by Office of Petroleum Coordinator, on basis of Bureau of Mines forecast of the nation's daily average requirements for domestic crude during month. State conservation authorities except Texas Railroad Commission have prescribed allowables calculated to hold actual production within OPC regulations. (Details on state allowable in The Oil Weekly of October 5, page 43.)

[2] In general, Texas fields will be shut down on October 3, 4, 10, 11, 17, 18, 24, 25 and 31, but the number varies in different fields.

them to continue operating stripper wells and to permit wildcatting under present high-cost conditions, and it is hoped that the action of OPA with regard to Lima crude may be followed by authorization of price advances also in other areas.

In the East Coast district, sales of fuel oils were held up last week by lack of rationing coupons, and the gasoline market was comparatively inactive, as demand failed to absorb readily the supplies available.

Refiners and marketers of the Middle West reported strong demand for all materials offered, as supplies were limited largely to current production, with very little in storage. Heavy demand from the East, particularly on heavy and light fuel oils, was superimposed on well-sustained demand within the district.

Refiners of the Mid-Continent, similarly, had all the business they could handle and many were obliged to turn away prospective purchasers, for lack of materials or transportation. Shortages of both transportation and supplies continue to limit sales in the district. Some suppliers complain that tank cars now are moving slower than formerly, requiring several days longer to make a return trip to the East. At the same time, it is conceded that some Mid-Continent refiners do not have adequate crude supply to fill potential orders for products. Owners of some plants report that they are operating far below capacity because of lack of crude.

On the Gulf Coast, as heretofore, the main problem is transportation. Refiners are obliged to operate plants at subnormal rates, in consequence of not being able to obtain tank cars to offset the shortage of tankers. However, some improvement over former conditions is reported, and there is a strong demand for Bunker C fuel oil.

Western Pennsylvania refiners continue to encounter firm demand for all products except neutral oils, which remain depressed in price under reduced demand and the absence of indications of any early improvement in demand. Bright stocks and cylinder stocks, in contrast, remain comparatively scarce and steady in price. Inventories of gasoline, kerosene, and burning oils are generally low, and there is ready demand for all of those materials offered.

Tanks Being Erected For Big Pipe Line

Contracts have been awarded by War Emergency Pipe Line, Inc., for dismantling and re-erecting 39 80,000-barrel steel tanks purchased in Oklahoma and Texas for use in the operation of the 24-inch line from Texas to Illinois. Eighteen of the big tanks are slated to be erected on the site of the East Texas field station in the A. R. Johnson survey, Gregg County.

Sinclair Prairie Oil Marketing Company furnished 24 of the tanks from its Oklahoma farms, Stanolind Oil Purchasing Company 5, Gulf Oil Corporation and Humble Oil & Refining Company 4 each and Tide Water Associated Oil Company 2.

Preliminary work is underway on the Longview station, which will be among the group slated to be in service shortly after the first of the year. A 16-inch gathering line will be extended from Longview station to a point in the East Texas field near Gladewater, and a combination 24- and 16-inch line to the Kilgore sector. These feeder lines will connect with the privately-owned trunk lines that are to supply the crude and burning oils.

Alberta Producers Seek Price Increase

An increase in the price of crude oil to provide additional funds for drilling operations and to offset declining oil production has been asked by the Alberta Petroleum Association in a submission to G. R. Cottrelle, Dominion oil controller.

Oil men say an increase would enable companies to drill out locations in proven areas of the field, and also help operators of small producers in the south end of the field continue operations.

The present field price for Turner Valley crude ranges from $1.43 to $1.97 a barrel, a price which is not on a competitive basis with Montana oil, according to operators.

Wholesale Prices of Refined Products in Principal Markets

REFINED GASOLINE	Current Range (Cents a gal.)		Changes from Month Ago	
Oklahoma Refineries:				
60 Octane and Under	5⅛	5¼	...	...
63-66 Octane	5½	5⅝	...	...
72-74 Octane	5⅞	6	...	...
80-82 Octane, Ethyl	6¾	6⅞	...	...
Mid-Western Tank Car:				
60 Octane and Under	5⅛	5¼	...	...
63-66 Octane	5½	5⅝	...	...
72-74 Octane	5⅞	6	...	...
80-82 Octane, Ethyl	6¾	7⅛	...	...
New York Harbor:				
68-70 Octane	9¼	9¼	...	...
72-74 Octane	9¼	10¼	...	...
Min. 80 Octane, '39 Research	9⅞	9⅞	...	...
Gulf Coast:				
60 Octane unleaded	5	5	...	...
65 Octane unleaded	5¼	5⅜	—⅛	...
68 Octane unleaded	5¼	5¼	...	—¼
70 Octane unleaded	5¼	5⅜	...	—⅜
72-74 Octane leaded	5½	6	+¼	...
Min. 80 Octane, '39 Research	5½	5½	...	...
NATURAL GASOLINE				
Grade 26-70:				
F.O.B. Group 3	3⅝	3⅝	...	...
F.O.B. Br'kenr'ge, Tex.	3¼	3¼	...	...
KEROSINE				
Oklahoma Refineries:				
41-43 water white	4⅝	4⅛	...	...
42-44 water white	4⅛	4⅝	...	...
Mid-Western Tank Car:				
41-43 water white	4⅝	4⅝	...	...
42-44 water white	4⅛	4⅛	...	...
New York Harbor	6⅞	6⅞	...	...
Gulf Coast:				
41-43 water white	3⅞	4¼	...	—⅛
RANGE OIL				
At Oklahoma Refineries	4	4⅛	...	...
In Mid-Western Market				
Group 3, basis	4	4⅛	...	...
LIGHT FUEL OILS				
Oklahoma Refineries:				
No. 1 prime white	3⅞	3⅞	...	...
No. 1 straw	3⅞	4	...	...
No. 2 straw	3⅝	3⅞	...	...
No. 3	3½	3½	...	...
Mid-Western Tank Car:				
No. 1 prime white	3⅞	4⅛	...	...
No. 2 straw	3⅝	3⅝	...	...
No. 3	3½	3½	...	...
New York Harbor:				
No. 1	6⅞	6⅞	...	...
No. 2	6¾	6¾	...	...
No. 3	6¾	6¾	...	...
Gulf Coast:				
No. 2	3¾	3¾	...	...

HEAVY FUELS	Current Range (Per Bbl.)		Changes from Month Ago	
Oklahoma Refineries:				
No. 6	$0.80	$0.90	...	...
14-16 Gravity	.95	.95	...	...
Mid-Western Tank Car:				
No. 5	.85	.85	...	...
No. 6	.80	.85	...	...
New York Harbor:				
No. 5	1.95	2.10	...	...
No. 6	1.65	1.65	...	...
BUNKER C FUEL OIL (Per barrel, ships' bunkers)				
Gulf Coast	$0.85	$0.90	...	...
New York Harbor	1.65	1.65	...	...
DIESEL OIL (Per barrel, ships' bunkers)				
Gulf Coast	$1.55	$1.68	...	...
New York Harbor	2.78	2.78	...	...
LUBRICATING OIL (Cents a gal.)				
Oklahoma Refineries:				
Bright stock (viscosity at 210°):				
200 vis. D, 10-25 pour point	.27	27	...	...
150-160 vis. D:				
0-10 pour point	.23	23	...	...
10-25 pour point	.22½	23	...	...
25-40 pour point	.23	23	...	...
150-160 vis. E	.22	22	...	...
120 vis. D, 0-10 pour point	.22	22	...	...
600 s.r. dark green	8½	8½	...	...
600 s.r. olive green	.10	11	...	...
631 s.r.	.18½	18½	...	...
Neutral Oils (viscosity at 100°, 0-10 pour point):				
Pale Oils:				
60-85 vis. No. 2 color	8	8	...	...
86-110 vis. No. 2 color	8½	8½	...	...
150 vis. No. 3 color	14½	14½	...	...
180 vis. No. 3 color	.15	15	...	...
200 vis. No. 3 color	.15	15	...	...
250 vis. No. 3 color	.16	16½	...	...
280 vis. No. 3 color	.17	17	...	...
300 vis. No. 3 color	.18	18	...	...
Red Oils:				
180 vis. No. 5 color	.15	15	...	...
200 vis. No. 5 color	.15	15	...	...
280 vis. No. 5 color	...	...	...	...
300 vis. No. 5 color	.17½	17½	...	...
Western Pennsylvania:				
Cylinder Stocks:				
600 s.r. filtrable	.15	15	...	...
650 s.r.	.15½	15½	...	...
600 flash	.16	16	...	...
630 flash	.17	17	...	...

LUBRICATING OIL (Cents a gal.)			Changes from Month Ago	
Bright Stock (No. 8 Color, 145-155 vis. at 210°, 540-550 fl.):				
10 pour test	30½	30½	...	...
15 pour test	29½	29½	...	...
25 pour test	25	25	...	...
Viscous Neutrals (No. 3 Color, vis. at 70°):				
200 (180 at 100), 420-425 fl.:				
Zero pour test	33	33	—7½	—7½
10 pour test	32	32	—7½	—7½
15 pour test	31	31	—7½	—7½
25 pour test	26	26	—2	—2
150 (143 at 100), 400-405 fl.:				
Zero pour test	31	31	—7½	—7½
10 pour test	30	30	—7½	—7½
15 pour test	29	29	—7½	—7½
25 pour test	24	24	—2	—2

CRUDE OIL PRICES UNCHANGED

Schedule of crude oil prices was unchanged during October, remaining as reported in THE OIL WEEKLY of July 6, 1942, pages 47-48.

MAJOR CRUDE OIL PRICE CHANGES

	Penna. Grade	Mid-Cont. (36 Gr.)	Calif. (26 Gr.)
Jan. 1, 1940	Up 25	.....	.....
Feb. 1, 1940	.....	.....	Cut *7
May 22, 1940	Cut 25	.....	.....
June 18, 1940	Cut 25	.....	.....
July 12, 1940	Cut 25	.....	.....
Aug. 28, 1940	Cut 15	.....	.....
Nov. 12, 1940	Up 15	.....	.....
Dec. 17, 1940	Up 15	.....	.....
Jan. 27, 1941	Up 15	.....	.....
April 1, 1941	.....	Up 5	.....
April 23, 1941	Up 10	.....	.....
April 24, 1941	.....	.....	Up *6
May 19, 1941	.....	Up 10	.....
May 21, 1941	Up 15	.....	.....
May 22, 1941	.....	.....	Up *6
June 18, 1941	Up 20	.....	.....
Aug. 14, 1941	Up 23	.....	.....
Aug. 25, 1941	Cut 23	.....	.....
March 26, 1942	Up 25	.....	.....

* Signal Hill 26 gravity.

U. S. Field Operations

Illinois Basin

Hamilton County Most Active Drilling Area

Hamilton County paces state in activity. Trenton well completed in Madison County. Activity picks up in Bible Grove field, Clay County, as the result of Cypress completions.

Hamilton County: The new Bungay area is one of the state's most active areas. Near completions there include Texas Co.'s Ernest 1, E½ NW NW 21-4s-7e, swabbing 354 bbls daily from Aux Vases at 3273-83 ft; Texas' Minton 2, E½ SW SW 21-4s-7e, swabbing 130 bbls of oil and 30 bbls of water a day following perforations in McCloskey at 3421-27 and 3350-58 ft. Two wildcats due for early drilling are Mid-Continent's Ruben 1, NE NE NE 22-3s-6e, and Oil Carriers, Inc.'s Rose 1, NE SE 36-3s-5e.

Madison County: Probably the best completion yet reported in the St. Jacob pool is Oil Carriers' Buchamann 2, SW NE SE 27-3n-6w, which pumped 597 bbls in 24 hours following an acid treatment in Trenton lime at 2327-40 ft.

Clay County: New Cypress completions have spurred activity in the Bible Grove field. They include Texas Co.'s Bloemker 1, SW SW NE 4-5n-7e, which pumped 65 bbls from sand at 2484-2515 ft; Texas Landwehr 3, NE NW NW 9-5n-7e, pumped 138 bbls in 11 hours from 2519-40 ft, after a 10-quart shot; Ohio's Peohler 1, NW SE NW 4-5n-7e, 225 bbls, and Ohio's Pehler 2, SE SE NW 4-5n-7e, 300 bbls. There have been earlier completions in the Cypress but most of them were small wells.

Edwards County: Stanolind Oil and Gas Co.'s Broster 1, SE SE NE 7-2s-10e, a wildcat, is testing McCloskey lime at 3416-21 ft after a second acid treatment.

St. Clair County: Wildcats scheduled for early drilling include: Mid-Sun and Smokey Oil Co.'s Richter 1, SE SE 14-1n-6w; same operator's Friederich 1, SW SE 17-1s-5e; same operator's Kinsella 1, NW SE 16-2n-8e. Mid-Sun recently completed Schanppe 1, SW NE 5-1n-8e as a dry hole at 2001 ft.

ILLINOIS FIELD COMPLETIONS

Clay County: J. P. Washburn's Baylor 1, c n½ ne nw 15-2n-7e, abnd 3119 ft.

W. C. McBride's Moench 1, se ne nw 10-3n-7e, Cyp 2592 ft, 71 bbls, 2605 ft.

Texas Co.'s Nadler 4, se sw sw 4-5n-7e, Weiler 2541 ft, 20 bbls, 2548 ft.

Cameron Bros.' Landwehr 2, nw ne ne 8-5n-7e, abnd 2825 ft.

Clinton County: E. Frank Jones' Middle Lake Club 1, se se ne 3-2n-2w, abnd 1275 ft.

Gulf's L. J. McAdams 1, sw se ne 35-3n-2w, Bethel 1225-39 ft, 12 bbls, 1252 ft.

Fayette County: Homer Luttrell et al's Aukamp B-3, nw sw se 30-5n-3e, Bethel 1898 ft, 76 bbls, 1907 ft.

Carter's Rhedemeyer 2, sw se ne 3-8n-3e, Weil 1496-1514 ft, Pt. Crk. Stray 1576-80 ft, Bethel 1610-12 ft, 312 bbls, 1629 ft.

Franklin County: E. S. Adkins' C. W & F. 3-E, nw ne se 35-6s-2e, Tar Spgs 2112-57 ft, 27 bbls, 2157 ft.

Gallatin County: Cherry & Kidd's Kerwin 2, se ne sw 11-8s-10e, Tar Spgs 2050 ft, 250 bbls, 2061 ft.

Hamilton County: Magnolia's Travis 1, e½ nw se 20-4s-7e, AV 3271-3301 ft, L. O'H 3334-38 ft, 648 bbls, 3459 ft.

Pure's Cox 2, se se ne 12-6s-5e, AV 3128-31 ft; 3140-65 ft, pb 3195 ft, 544 bbls 22 hrs, 3240 ft.

Results on Industry's Prospecting Fronts

Only 7 out of 60 wildcats reported completed during last week were oil producers. For the year, 2616 wildcats completed have added 335 oil producers.

Dakotas: Four drilling operations and four geophysical parties are busy.

Arkansas: New gas field in Pope County.

Gulf Coast: New Wilcox field indicated in Montgomery County. Gas strike in Goliad.

Kansas: New Kansas City-Lansing pool in Barton County.

Illinois: Activity picks up following Cypress success in Clay County.

Magnolia's Hamilton 5, nw sw se sw 24-6s-5e, AV 3112-23 ft, 109 bbls, 3129 ft.

Ohio's Moore 5, ne ne nw 35-6s-5e, AV 3276-82 ft, 3286-92 ft, pb 3296 ft, 11 bbls, 3369 ft.

Ohio's Moore's 6, ne nw se 35-6s-5e, abnd 3420 ft.

Carter's Julie Mayberry 2, se sw sw 12-6s-5e, AV 3062-78 ft, 77 bbls, 3079 ft.

Nash Redwine's L. Irvin 1, c e½ se nw 35-6s-6e, AV 3134-49 ft, 311 bbls, 3149 ft.

Texas Co.'s Miller 2, nw se sw 8-6s-7e, abnd 3079 ft.

Pure's Layman A-2, nw se nw 17-6s-7e, Weiler 2746-82, pb 2786 ft, 122 bbls, 3062 ft.

Pure's Johnson 1, nw sw se 18-6s-7e, Weiler 2747-69 ft, pb 2770 ft, 309 bbls, 3210 ft.

Shell's Webb 1, nw ne sw 18-6s-7e, AV 3044-90 ft, 1028 bbls, 3101 ft.

Jefferson County: J. Vawter's Kell 1, sw sw ne 9-1s-1e, temp abnd 2081 ft.

Shell's Burkhardt 7, nw nw ne 35-2s-1e, Bethel 2003 ft, 20 bbls, 2023 ft.

Nash Redwine et al's Wilmore Comm. 1, sw nw sw 27-3s-3e, AV 2744-77 ft, 20 bbls, 2808 ft.

Larlo O&G et al's Jacobson & Starr 2, c e½ se sw 1-3s-4e, McCl 3111-19 ft, 53 bbls, 3210 ft.

Tide Water's Newton Inv. B-2, c n½ nw se 1-3s-4e, McCl 3080-86 ft, 133 bbls, 3094 ft.

Lawrence County: E. O. Olds' Van Wey 3, e½ nw se se 23-2n-12w, Buch 1317-23 ft, 100 bbls, 1389 ft.

Moindia Oil Co.'s Hershey 6, sw se se 27-2n-12w, Biehl 1364-89 ft, Bethel 2979-2994 ft, 60 bbls, 2994 ft.

E. O. Olds et al's Stoltz 1, ne ne sw 28-2n-12w, abnd 2135 ft.

F. Jablonski's Tanquary 1, ne ne ne 34-2n-12w, Bethel 2006 ft, 150 bbls, 2018 ft.

Madison County: Sinclair-Wyoming's Ellis 1-C, sw se sw 27-3n-6w, abnd 1884 ft.

Richland County: Pure's Coen 32, c ne¼ 9-3n-9e, Cypress 2591-2615 ft, 168 bbls, 2640 ft.

Helmerich & Payne's Von Alman 1, c s½ nw se 31-5n-14w, abnd 3039 ft.

Wabash County: Magnolia's Meredith 3, se sw ne 30-2s-13w, Weiler 2469 ft, 40 bbls, 2485 ft.

Wayne County: F. Jablonski et al's Totten-Shelton 2, c se se 35-1n-8e, McCl 3132 ft, 616 bbls, 3144 ft.

N. V. Duncan's Milner 1, ne nw sw 9-1s-7e, abnd 3249 ft.

E. V. Schulte et al's Morris 1, ne sw se 11-1s-7e, AV 3082-95 ft, 220 bbls, 3100 ft.

Pure's Tubbs 2, sw nw sw 12-1s-7e, abnd 3208 ft.

Deep Rock Oil Corp.'s Sanford 2, se ne 30-1s-7e, McCl 3233-40 ft, 250 bbls, 3240 ft.

White County: Cal Star Pet's Miller-Ford 20-B, ne nw se 21-4s-14w, AV 2820-30 ft, 72 bbls, 2855 ft.

Magnolia's Jones 4, se se ne 7-4s-10e, T. S. 2491-2500 ft, 60 bbls, 2500 ft.

Jarvis Bros. and Marcell's Spencer 4, sw ne sw 31-4s-11e, T.S. 2287-2318 ft, 455 bbls, 2318 ft.

Pure's Pyle Consol 1, nw se se 18-6s-9e, Pt. Crk. 2760-2805 ft, 404 bbls, 2805 ft.

Magnolia's Sisson-Higgins 15, se ne se 24-6s-10e, Tar Spgs 2260 ft, 45 bbls, 2274 ft.

Magnolia's Gen. Amer. Life 5, nw se sw 1-7s-8e, Walt 2220 ft, 65 bbls, 2231 ft.

Magnolia's Gen. Amer. Life 6, sw se sw 1-7s-8e, Walt 2207 ft, 67 bbls, 2219 ft.

ILLINOIS WELL DEEPENED

White County: Riddle & Yingling's Meyers 1, c nw se sw 12-6s-10e, otd 2110 ft, Tar Spgs 2252 ft, 52 bbls, 2260 ft.

ILLINOIS WILDCAT COMPLETIONS

Clay County—Failure: Gulf's McCollum 1, nw sw se 24-4n-6e, abnd 3110 ft.

Edwards County—Failure: F. Jablonski et

U. S. Drilling Operations in Week Ended October 31, 1942

STATE	ALL WELLS COMPLETED — THIS WEEK Total	Oil	Gas	Dry	*Miscel.	Total 1942	Total this Date 1941	WILDCATS COMPLETED‡ — THIS WEEK Total	Oil	Gas	Dry	Distillate	Total 1942
Alabama						3	5						3
Arizona						2							2
Arkansas	5	2		3		118	162	2			2		20
California	15	10		5		626	963	5			5		102
Colorado						14	15						2
Florida							1						
Georgia						2	1						2
Illinois	53	36		16	1	1,792	3,314	6	1		5		490
Indiana	11	3	2	6		334	454	1			1		84
Iowa							6						
Kansas	34	18	2	13	1	1,394	1,912	8	1	1	6		316
Kentucky	5	3		2		132	273	1			1		33
Louisiana	14	5	2	7		800	1,306	3			3		127
Michigan	14	4	2	8		588	708	4			4		156
Mississippi	3			3		94	184	3			3		36
Missouri						24	68						
Montana	1	1				175	180						2
Nebraska						28	78						14
New Mexico	8	5		3		338	325						37
New York	22	14			8	1,034	847						1
Ohio	21	6	11	4		934	1,484						
Oklahoma	22	6	2	11	3	1,213	1,863	4			4		259
Pennsylvania	44	41	2	1		3,256	3,399						
Tennessee						8	19						
Texas	67	34		28	5	4,610	8,834	23	5		18		926
Utah							3						
Virginia						1							
West Virginia	11	2	7	2		621	621						
Wyoming	1	1				87	114						4
Total this week	351	191	30	112	18	18,228	27,139	60	7	1	52		2,616
Total last week	394	232	29	115	18	17,877	26,416	83	15	1	67		2,556
Total this year	18,228	9,463	1,563	4,790	2,412			2,616	335	42	2,231	8	

* Includes old wells deepened, water intake, gas input, salt water disposal, and distillate wells.
‡ OPC program calls for 4,000 wildcats in 1942, of which 624 should produce oil and 116 gas, leaving 3,260 dry.

al's Bristow 1, c w½ sw nw 30-1n-11e, abnd 3310 ft.

Jefferson County—New Field: Gulf's Bradford 1, nw se sw 14-1s-4e, L.O'H. 2791-97 ft, McCl 2854-60 ft, 15 bbls oil, 30 wtr, 2981 ft.

Lawrence County — Failure: Ray Rothlei's Dager 1, se se ne 20-2n-12w, abnd 2392 ft.

St. Clair County—Failure: C. W. Young's Hotz 2, c s½ ne sw 29-3s-6w, abnd 630 ft.

Washington County — Failure: Texas Co.'s Bain 1, ne ne nw 26-3s-2w, abnd 1668 ft.

ILLINOIS WILDCAT STARTS

Clay County: National Refg. Co.'s Geo. LaRue 1, ne se sw 9-4n-8e, lcn.

Clinton County: Central States Oil Co.'s Schreiber 1, se ne sw 25-2n-2w, dr.

Effingham County: Standard Drlg. Co.'s Dunterman 1, nw sw ne 23-9n-5e, lcn.

Madison County: Ledbetter & Gardenhire's Holtman 1, c ne se 20-4n-7w, lcn.

Marion County: Deaton & Bears' Mays 1, sw se sw 25-1n-2e, lcn.

Richland County: Nadel & Gussman's T. F. Eaton 1, c se sw 26-3n-14w, dr.

Wayne County: Harry Fotiades' Shewmake 1, c s½ sw se 23-1n-5e, lcn.

Deep Rock's Atkinson-Windland 1, c ne sw 12-2s-6e, lcn.

INDIANA FIELD COMPLETIONS

Decatur County: Public Service of Ind.'s Schoetter 235, c sw sw 14-9n-9e, Trenton 884 ft, 142,000 gas, 920 ft.

Public Service of Ind.'s Vierkamp 233, c nw ne 22-9n-9e, Trenton 878 ft, 75,500 gas, 918 ft.

Gibson County: McGinnis & Bittler's Doris Michel 2, sw se se 26-1s-10w, abnd 1850 ft.

Harrison County: Harrison Dev. Corp.'s McGrain Bros. 1, c nw sw 30-3s-4e, abnd 803 ft.

Randolph County: Unionport O & G's India Brumfield 1, s½ sw sw 25-20n-13e, abnd 1081 ft.

Unionport O & G's Brooks 1, c se sw 34-20n-13e, abnd 1105 ft.

Sullivan County: W. F. Sowers' W. J. Huff 1, se nw ne 34-8n-10w, abnd 845 ft.

Vanderburg County: Sells Pet.'s McCarty Unit 1-A, sw ne nw 32-6s-11w, Walt 1738-53 ft, 50 bbls, 1760 ft.

Sells Pet.'s McCarty 2, s½ se nw nw 32-6s-11w, Walt 1754 ft, 38 bbls, 1774 ft.

Sells Pet.'s McCarty Unit 2-A, ne ne nw 32-6s-11w, Walt 1812 ft, 70 bbls, 1822 ft.

INDIANA WILDCAT COMPLETION

White County—Failure: J. W. McNail's J. K. Wheeler 1, s½ nw nw 15-27n-6w, abnd 138 ft.

INDIANA WELL DEEPENED

Posey County: Baldwin et al's Reichart 1, c se nw se 25-7s-15w, dr.

KENTUCKY FIELD COMPLETIONS

Henderson County: Cherry & Kidd's Burbank 1, 24-Q-21, Cyp 2306-16 ft, McC 2674-83 ft, 155 bbls, 2685 ft.

McLean County: Stewart et al's Watson 1, 5-N-25, Stray sd 649-58 ft, 10 bbls, 660 ft.

Ohio County: Ellis Massey's Moseley 8, 25-N-31, abnd 910 ft.

Union County: Pure's Richards A-2, 10-O-19, McC 2543-47 ft, 412 bbls, 2600 ft.

KENTUCKY WILDCAT COMPLETION

Daviess County—Failure: J. C. Miller et al's Payne 1, 24-O-29, abnd 1277 ft.

KENTUCKY WILDCAT START

Henderson County: W. F. Lacy et al's Cavenaugh 1, 20-Q-21, dr.

Oklahoma

Liberty Field Well Makes Good Flow

Liberty field gets important well. Mississippi lime test undecisive at Morrison. New field east of Beebe. Shawnee extended.

Noble County: Deep Rock's Dailey 1, NE NW NE 10-22n-2e, 1 mi northeast of the discovery of Liberty field in the Wilcox sand, flowed 928 bbls, in 13 hrs from Wilcox at 4369-71 ft. No water is showing. Well gives material encouragement to this area after it was apparently condemned by failures.

E. J. Kubat et al's Tyer 1, NE NE SW 7-21n-3e, near Morrison, is still testing and apparently will make a producer from Mississippi lime at 4024-4055 ft. Oil fillup has slowed after initial testing.

Pantotoc County: W. A. Delaney, Jr., et al's Roper 1, C NW NW 26-5n-5e, 2 mi east of Beebe pool, is flowing to open a new Viola lime field. On 13-hr test well made 396 bbls from Viola at 2460-2552 ft.

Pottawatomie County: Atlantic et al's Whistler 1 NW SW SE 18-11-5e, near production in the Northeast Shawnee area, drilled plugs to fillup at an estimated rate of 25 bbls hourly from Wilcox sand at 4835-4853 ft.

OKLAHOMA FIELD COMPLETIONS

Caddo County—Cement: Phillips' Fletcher 5, c nl n½ nw 34-6n-10w, 5 mcfg, 6546 ft.

Coal County—Jessie: W. A. Selaney's Jipson 1, sw se ne 7-1n-8e, Hunton 3715 ft, flow 40 bbls, 4611 ft.

Creek County—Cushing: Platterf's B. Trent 1, ne sw nw 9-16n-7e, Layton 1476 ft, abnd 1523 ft.

Creek County—Kellyville: Keram & Moore's Mike 1-A, c se sw 5-16n-10e, abnd 800 ft.

Creek County—Slick: O. H. P. Thomas et al's Ada Jack 1, se se sw 27-16n-10e, lime 2356-58 ft, abnd 2440 ft.

Creek County—Glenn: L. B. Jackson's Vowell 42, c se sw 16-17n-12e, Glenn 1426 ft, 2 mcfg 1865 ft.

Pure's Boling 9, nw nw ne 2-17n-12e, Glenn 1490-1550 ft, shot 40 qts, pump 10 bbls, td 1555 ft.

Garvin County—Pauls Valley: Pure's Campbell-Maxey 1, se nw ne 36-4n-1w, Penn 3859 ft, pb 3950 ft, flow 425 bbls, 4103 ft.

Kay County — Delworth: C. A. Leonard's Hitch 2, ne nw sw 19-28n-1e, sand 3321 ft, pump 54 bbls, 3325 ft.

McIntosh County — Semi-Wildcat: W. H. Peckham's Coch 1, c ne se 3-12n-16e, abnd 2825 ft.

Noble County—Otoe City: Graham et al's Donohue 1, c w½ ne se 16-22n-1e, Tonkawa 2750-2800 ft, pb 2800 ft, shot off pipe with 6 qts 2761 ft, flow 95 bbls oil, 20 wtr, 15 mcfg, td 3421 ft.

Noble County—Liberty: Sunray's Schultz 2, nw se se 9-22n-2e, Tonkawa 2586-91 ft, shot 5 qts 2586-91 ft, pb 2700 ft, salt disposal well, 4850 ft.

Pawnee County — Lauderdale: Major Oil Co.'s Baker B-1, c n½ ne nw 9-20n-8e, Bartlesville 2450 ft, pump 20 bbls oil, 20 wtr, 2480 ft.

Stephens County—Velma: Skelly's Selby 37, se ne se 26-1s-5w, abnd 1300 ft.

Tulsa County—Bixby: Cummings Oil Co.'s Bigpond 1-A, nw ne se 28-17n-13e, abnd 2153 ft.

Tulsa County—Jenks: Sand Springs Home's Nixon 2, se ne ne 31-18n-13e, lime 2350 ft, abnd 2410 ft.

OKLAHOMA WELLS DEEPENED

Creek County—Kellyville: Lewis Abraham's McIntosh 2, sw nw ne 7-16n-10e, otd 2351 ft, Miss 3150 ft, abnd 3168 ft.

Oklahoma County—Oklahoma City: Clark's Wheeler 1, c n½ s½ 15-11n-3w, otd 6528 ft, sand 6376 ft, shot 120 qts, pump 20 bbls oil, 20 wtr, 6563 ft.

OKLAHOMA WILDCAT COMPLETIONS

Creek County—Failures: Carter's Rippetoe 1, nw nw se 24-14n-7e, Osw 2594 ft, 2nd Wx 4165 ft, abnd 4165 ft.

L. B. Jackson's Noble 1, c ne nw 3-19n-8e, temp abnd.

McIntosh County—Failure: W. H. Peckham's Koch 1, c ne se 3-12n-16e, Cromwell 2772-2825 ft, abnd 2825 ft.

Noble County—Failure: K.G.F.F. & Portable's Horash 1, nw ne ne 22-22n-2e, Miss 4195 ft, abnd 4602 ft.

Payne County—Failure: Starr & Kubat's Hesser 1, nw nw se 27-20n-3e, temp. abnd.

OKLAHOMA WILDCAT STARTS

Haskell County: J. C. Mulhall's Billington 1, nw nw nw 31-9n-19e, lcn.

Hughes County: Otha Grimes' Barnett Consolidated 1, se sw se 24-8n-10e, Booch 2353-68 ft, nso, dr 2630 ft.

Kay County: Norbla & Deep Rock's Farnsworth 1, ne ne se 6-27n-5e, rur.

Lincoln County: Wilcox O & G & H. E. Crosbie's Battle 1, se se ne 30-14n-5e, lcn.

Deep Rock's Arno 1, c nw ne 4-16n-5e, lcn.

Osage County: Norbla & Sinclair's Osage 1, nw nw nw 17-23n-7e, lcn.

Pottawatomie County: Phillips' Nix 1, c sw se 26-8n-3e, c&p.

Kansas

New Kansas City-Lansing Pool in Barton County

New Kansas City-Lansing lime pool. Major extension at Lindsborg. Another well for Lily.

Barton County: Nate Appleman's Stull 1, C S½ SE SW 6-16-12w, north of Beaver field, has opened a new lime pool in the Kansas City-Lansing at 3040 to 3074, with total depth 3331 ft. After treating with 2000 acid, well flowed 100 bbls in 15 minutes, then settled down to make 50 bbls per hour for three hours.

McPherson County: Lario Oil & Gas Co.'s Beane 1, NE SW 25-17-4w, near Lindsborg field, is showing for a new pool, or more probably a major extension of the field's Viola lime production. Well swabbed 50 bbls in one hr from 3401-3406 ft, through perforations. With this agitation, well began filling and flowed over casing top.

McPherson County: In the Lily pool, a recent discovery, Republic Natural Gas Co.'s Tinker 1, C S½ SE SE 30-17-1w, drilled top of chat at 2659 ft and is preparing to test.

KANSAS FIELD COMPLETIONS

Barton County—Kraft Prusa: Geo. Johnston et al's Oeser-North 2, ne ne nw 30-16s-11w, Lans 3057 ft, pay 3064-68 ft, 500 gals acid, pump 248 bbls, 3068 ft.

Bartlett & Crum's Staatz C-1, nw sw sw 23-17s-11w, abnd 140 ft.

Republic Nat'l's Bloomer B-4, c sw nw 14-17s-11w, Arb 3300 ft, 3500 gals acid, pump 528 bbls, 3325 ft.

Vickers' Soeken 3, ne se se 2-17s-11w, Arb 3286 ft, 1000 gals acid, pump 15 bbls, 3306 ft.

Barton County—Stickney: B. Mabee et al's Stoskopf 2, se sw nw 29-16s-13w, Granite wash 3378 ft, abnd 3396 ft.

R. Olsen and Anderson-Pritchard's Stoskopf 2, se se nw 29-16s-13w, Arb 3384 ft, shot 5 qts 3387-91 ft, 1500 gals acid, pump 12 bbls oil, wtr, 3391 ft.

Butler County—Potwin: Bennett & Abels' Maxwell 3, se nw ne 31-24s-4e, Miss 2655 ft, abnd 2726 ft.

Cowley County—Semi-Wildcat: Stelbar Oil Co.'s Knapp 1, c sw nw 23-32s-3e, Arb 3466 ft, abnd 3485 ft.

Ellis County — Bemis: Champlin's Hadley B-6, c e½ nw sw 29-11s-17w, Arb 3468 ft, perf 3478-95 ft, 1500 gals acid, 2346 bbls, 3505 ft.

Ellsworth County — W. Stoltenberg: Gulf's Svoboda 5, c nw se 8-16s-10w, Arb 3308 ft, 3000 gals acid, pump 179 bbls oil, 333 wtr, 3324 ft.

Greenwod County—Virgil: LeBlanc's Sharp 1, c w½ nw sw 7-24s-13e, Miss lime 1639 ft, pay 1645-57 ft, 3000 gals acid, shot 50 qts, pump 5 bbls, 1672 ft.

Greenwood County — Beaumont: K. T. Weidenman's Edgar 1-B, c ne ne 10-28s-8e, Arb 3076 ft, abnd 3105 ft.

Jefferson County — McLouth: Hatcher & Fisk's Hesse 3, c sw sw 21-9s-20e, sand 1364 ft, 10 mcfg, 1373 ft.

Marion County—Lost Springs: Adair Morton's Stuchlik 1, c ne nw 32-17s-4e, Miss 2396 ft, pump 300 bbls oil, 42 wtr, 2404 ft.

Ring Mac's Bernhardt 1, c w½ ne sw 4-18s-4e, Miss chat 2412 ft, abnd 2455 ft.

Pratt County—Iuka: Atlantic et al's Harrell C-1, sw sw se 2-27s-13w, Simp 4247 ft, flow 987 bbls, 4256 ft.

Reno County—Peace Creek: Cities Service's Keesling 4, sw se sw 1-23s-10w, Viola 3731 ft, 500 gals acid, flow 3000 bbls, 3737 ft.

Rice County — Un-named: Cities Service's Finger 1, c nw ne 25-19s-10w, Arb 3326 ft, abnd 3343 ft.

Rice County — Keesling: Cities Service's Dick A-2, c se sw 9-20s-9w, Arb 3240 ft, 1500 gals acid, pump 530 bbls, 3255 ft.

Rooks County—Laton: Max Cohen's Doane 3, c nw se 34-8s-16w, Lans 3092 ft, 3000 gals acid, pump 514 bbls, 3156 ft.

Russell County — Russell: Aylward and British American's Ehrlich 1, c w½ sw nw 15-13s-14w, Lans 2978 ft, pb 2995 ft, pump 430 bbls, 3291 ft.

Russell County—Hall Gurney: Skelly's Ehrlich 6, c se sw 32-14s-13w, Lans 2890 ft, pb 3162 ft, 6500 gals acid, pump 948 bbls, 3197 ft.

Russell County — Trapp: Braden & McClure's Resner 2, c nw nw 23-15s-14w, Arb 3332 ft, 1000 gals acid, pump 1743 bbls, 3336 ft.

Stafford County — Stafford: Stanolind's Schneider 1, c nw½ sw sw 11-24s-12w, Viola 3825 ft, 2000 gals acid, flow 3000 bbls, 3836 ft.

Sumner County—N. Vernon: Sinclair-Prairie's Herrick 7, sw ne ne 15-35s-2e, Bartl 3410 ft, shot 120 qts, pump 173 bbls, 3470 ft.

KANSAS WELLS DEEPENED

Jefferson County—McLouth: McLaughlin & Sons' Bartlett 1, c sw sw 33-9s-20e, otd 1430 ft, Miss 1454 ft, hfw 1602-08 ft, abnd 1608 ft.

KANSAS WILDCAT COMPLETIONS

Ellsworth County—Failure: Cities Service's Steiner 1, se se sw 7-15s-9w, Topeka 2775 ft, Lans 2651 ft, Arb 3041 ft, Por 3049-51 ft, abnd 3080 ft.

Greenwood County—Failure: K. T. Weidemann's Edgar 1, c ne ne 10-28s-8e, Miss 2767 ft, Base Miss 3040 ft, Arb 3076 ft, pb 2781 ft, abnd td 3106 ft.

Leavenworth County—New Gas Field: Roxan Oil Co.'s O'Keefe 2, c nw sw 20-11s-22e, 500,000 gas, 850 ft.

Rooks County — Failure: Cities Service's Baumgartner 1, ne ne ne 25-8s-19w, Topeka 3980 ft, Lans 3231 ft, Sooy 3489 ft, Eros Arb 3637 ft, Arb 3648 ft, abnd 3486 ft.

Russell County—New Field: Aylward Prod. et al's Ehrich 1, sw sw nw 15-13s-14w, Anhy 840 ft, Lans 2978 ft, Arb 3244 ft, perf 3002-05

ft, 143 bbls oil 8 hrs, 4 percent bw and wtr, td 3294 ft.

Russell County—Failure: Hollow Drlg. Co. and N. Appleman's Dumler 1, sw se sw 5-14s-13w, Anhy 820 ft, Topeka 2680 ft, Lans 3040 ft, Marmaton 3275 ft, Cong. 3333 ft, abnd 3394 ft.

Sherman County—Failure: Sinclair Prairie's Mercer 1, ne ne nw 28-10s-40w, abnd 3785 ft.

Stafford County—Failure: S. A. Murphy et al's Central Life 1, c w½ sw ne 25-21s-11w, abnd.

KANSAS WILDCAT STARTS

Barton County: Ramsey Petroleum's Heinz 1, se sw se 4-18s-11w, Anhy 615 ft, drl 1600 ft.

Phillips' Hawkins 1, c sw nw 3-19s-13w, lcn.

Butler County: O. J. Connell et al's Getz 1, sw sw nw 33-28s-6e, lcn.

Cowley County: Margay Oil Co.'s Thompson 1, nw nw se 3-32s-3e, dr.

Deep Rock & Globe's Parsons 1, c s½ sw nw 24-32s-3e, lcn.

Ellis County: N. Appleman's Gunther 1, ne ne sw 8-11s-19w, lcn.

Graham County: Aladdin Pet. Co.'s Moore 1, c w½ sw sw 22-8s-25w, rig.

Marion County: Wolf Creek's Mehl 1, ne sw sw 5-20s-5e, dr 775 ft.

Reno County: C. J. Burton et al's Krehbiel 1, c se se 10-26s-7w, brr.

Rush County: Continental's Munch 1, nw ne ne 9-16s-19w, brr.

Russell County: Auto Ordnance Corp.'s Sutton 1, sw sw nw 2-12s-15w, mim.

Cities Service's Johnson C-1, nw nw ne 22-13s-15w, lcn.

Wallace County: Sinclair Prairie's Wallace Investment 1-A, sw sw sw 23-11s-39w, brr.

New Mexico

NEW MEXICO FIELD COMPLETIONS

Eddy County: Continental's State 3-36, c ne nw 36-16s-30e, flow 240 bbls, ¾-in, pay 2967-71 and 3004-13 ft, td 3025 ft.

Danciger's Turner 8-B, c nw ne 20-17s-31e, flow 240 bbls, 2-in, 3419-34 ft.

Danciger's Turner 9-B, c ne ne 20-17s-31e, flow 140 bbls cas, 3473-85 ft.

McDannald Oil Co. and Williams' Grier 2, 605 ft from w and 1980 ft from s 30-16s-31e, flow 60 bbls 2-in, 3049-3141 ft.

Lea County—Monument: G. M. McGarr et al's Weir 2-A, nw se sw 3-20s-37e, acid 10,000 gals, abnd 3929 ft.

Lea County—Salt Lake: Continental et al's Brooks 3-A-7, c sw se 7-20s-33e, pump 288 bbls 29-gr, 2975-3025 ft.

NEW MEXICO WILDCAT COMPLETIONS

Chaves County—Failure: Harry Steinberger et al's Headley 1, c nw ne 26-14s-29e, elev 3862 ft, salt 320-1050 ft, white lime 2440 ft, abnd 4200 ft.

Lea County—Failure: Geo. P. Livermore-DeKalb Agricultural Assn's State-Maxwell 1, c nw nw 26-15s-34e, elev 4077 ft, anhydrite 1793 ft, salt 1895-2800 ft, Yates grains 2930 ft, San Andres 4555 ft, Glorietta 6085 ft, abnd 6308 ft.

West Texas

Embar Pool Gets First Producer in Ellenburger

Embar pool lists first producer in Clear Fork and Ellenburger zone is widened to west. Completion test underway on Clear Fork prospect in Monahans area. Barnhart pool records ninth consecutive producer in 9000-ft pay, and assigned 2 more tests. Crane County Ordovician prospect abandoned after yielding small amount of oil. Considerable deep explorations slated for southeast portion of Permian Basin.

Andrews County: Phillips' University-Andrews 9, 9/16-mile southeast of its Embar pool Ellenburger discovery, flowed 104 bbls of oil, plus 10 percent bs&w, on completion gauge following acid treatment through perf at 6210-75 ft. This outpost was dry in Ellenburger at 8174 ft, and is first producer for area in Clear Fork (Tubb) zone of the Permian. Company's University - Andrews 11, ¾-mile west of discovery, became fourth Ellenburger producer in flowing 146 bbls of oil on 8-hr test through ¾-in, acidized with 750 gals at 7799-7865 ft. Atlantic et al's University-Texu 1-A, wildcat, was drilling lime and shale at 10,550 ft.

Ward County: Shell's Sealy-Smith 2, 1476 ft west by north of its 10,082-10,364-ft Ellenburger discovery for the Monahans pool, was making completion test through perf at 5633-43 ft in lower section of Clear Fork saturation. Drillstem tests previously established comparatively thick producing zone before reaching water at 5660-5741 ft. Development of the deep zone is likely to be held in abeyance should attractive production occur in the Clear Fork.

Sutton County: S. B. Roberts et al's Allison 2, southeast offset to an Ellenburger failure that passed up gas shows, developed 1,500,000 ft of gas from Canyon at 3720-35 ft, and halted in shale 3740 ft to run pipe.

Ordovician Prospect: Skelly's Richardson 1, southeastern Crane County wildcat and 7 miles north by west of Wentz pool, nearest Ordovician production, yielded sufficient oil and gas following 3-stage acid treatment of Ellenburger at 5465-5504 ft before plugging orders were issued to assure continued explorations in the area. This wildcat plugged back from prolific sulphur water at 5725-43 ft, elevation 2341 ft. The 568-ft section of Simpson, topped at 4897 ft, proved barren. The Ordovician series was encountered considerably higher than anticiapted. Gulf's Dawson 1-A, scheduled Ordovician wildcat 8 miles north of Richardson 1, was trying to restore circulation at 2460 ft.

Deep Projects: Extensive geophysical operations conducted in the southeast portion of the Permian Basin within the past several years has resulted in the starting of scheduled Ordovician tests in Sterling County by Ohio and Col-Tex Refining Company (Anderson & Prichard and Standard of Texas) and by Humble on a huge block in east central Reagan County. Details and projected depths of this trio are given under West Texas wildcat starts. Plymouth Oil Co. plans to drill an Ordovician test on its Sterling County block, centering upon H&TC 54, Blk 2, 11 miles northwest of Sterling City.

Reagan County: R. R. Ogden and R. H. Hawn's University 1-B, east edge of Barnhart field, flowed 180 bbls, including 6 percent acid water, on 7-hr test through ¼-in after using 7000 gals acid, Ellenburger perf at 9135-9200 ft. Amerada has 2 southwest edge tests due for completion early in November, and has locations for 2 inside tests.

Wildcats: Humble's Newman 1, Scurry County's first sub-Permian test, was drilling middle Pennsylvanian series at 7410 ft. Shell's Blue 1, eastern Winkler County, drilling dry lime at 6460 ft, and company's Leaverton 1, Gaines County, drilling 5895 ft, with sulphur water at 5828-81 ft. In Pecos County, Phillips' Price 1 was drilling at 6110 ft. The Texas Co.'s Robertson 1, recent Gaines County strike from stray porosity in Permian 5910-50 ft, flowed 80 bbls of 29-gr oil on last gauge. Pumping unit has been set, and official gauge delayed pending completion of 3-in pipe line to Magnolia's nearby carrier.

WEST TEXAS FIELD COMPLETIONS

Andrews County—Embar: Stanolind's University 1-W, c sw nw sec 19, blk 10, elev 3274 ft, Yates 2720 ft, San Andres 4150 ft, base Permian 7850 ft, abnd 8374 ft (above Ordovician).

Andrews County—West Andrews: Atlantic's University 1-C, c ne sw sec 24, blk 11, elev 3299 ft, abnd 6600 ft.

Cochran County — Slaughter: Continental's Dean 9, 2008 ft from e and 3253 ft from s lines 1600-ac lse, leag 58, Martin CSL, flow 1007 bbls, acid 12,000 gals 4935-89 ft.

Honolulu's Mallet 26-A, 580 ft out sec lab 5, leag 51, Scurry CSL, flow 872 bbls, 2½-in, acid 6000 gals, 5046-67 ft.

Ector County—Goldsmith: Carl B. King Drl. Co.'s Cummins-Tidal 1-A, 440 ft from n and 880 ft from w T&P 32, blk 45, T-1-N, flow 78 bbls ⅝-in, acid 5500 gals 4228-75 ft.

Ector County—North Cowden: Sinclair Prairie's Glass 2-B, 660 ft from n and 732 ft from e ne nw T&P 18, blk 43, T-1-N, flow 637 bbls, 2-in, acid 5000 gals 4460-4760 ft.

Hockley County — Slaughter: Devonian Oil Co.'s Hudgens 7, s½ PSL 8, blk X, flow 1165 bbls cas, acid 4985-5025 ft.

T. F. Morrow et al's Mallet 2, 580 ft out sec lab 23, leag 48, Edwards CSL, flow 673 bbls, 2-in, acid 12,000 gals 4939-87 ft.

Western States Gasoline Corp.'s Mallet 16-B, 510 ft out sec lab 25, leag 49, Scurry CSL, flow 960 bbls, acid 9500 gals 4990-5030 ft.

Pecos County—Walker: Cardinal Oil Co.'s University 4-C, 1628 ft from n and 3316 ft from w lines sec 25, blk 16, flow 80 bbls, 1-in, shot 80 qts 1755-85 ft.

Reagan County—Skelly-Grayson: Skelly et al's University-Grayson 7, se se ne sec 34, blk 8, pump 33 bbls, 3078-3105 ft.

Ward County: Texas Co.'s University 5-C, 572 ft from e and 3281 ft from s lines sec 5, blk 16, flow 171 bbls, 5% bs&w, 2-in, shot 120 qts 2490-2530 ft, td 2536 ft.

Ward County—South Magnolia-Sealy: Atlantic & Standard of Texas' University 2, c se nw sec 12, blk 16, flow 536 bbls, ¼-in, lime 2913-17 ft.

WEST TEXAS OLD WELLS DEEPENED

Pecos County — Taylor - Link: Stanolind's (was Landreth) University 5-K, otd 1740 ft, pump 74 bbls oil, 17 water, acid 1000 gals 1730-75 ft.

Ward County: Tide Water Associated's Johnson 24, H&TC 28, blk 34, otd 2613 ft, flow 508 bbls, ¾-in, shot 205 qts 2900-3000 ft.

WEST TEXAS WILDCAT COMPLETIONS

Andrews County—Embar field new pay: Phillips' University-Andrews 9, c nw nw sec 32, blk 10, elev 3234 ft, flow 104 bbls, 10% bs&w, 2-in, acid 1000 gals Clear Fork (Tubb zone) perf 6210-75 ft, td 8174 ft.

Crane County—Failure: Skelly's Richardson 1, 7190 ft from ne and 660 ft from se lines H&TC 5, blk 31, elev 2341 ft, base Permian 4870 ft, top Simpson 4897 ft, Ellenburger 5465 ft, sul water 5725-43 ft, td, abnd after pb for nominal show oil and gas after 3-stage acid 13,500 gals 5460-5504 ft.

Dickens County—Failure: Isaac Deck et al's McMahan 1, 1320 ft from n and 675 ft from w lines H&GN 319, blk 1, abnd 1204 ft.

Lubbock County—Failure: John R. Sharp et al's Elliott-Stanolind 1, c ne ne EL 33, blk D-5, elev 3307 ft, anhydrite 1840 ft, brown lime 3230 ft, solid lime 3500 ft, Clear Fork 5260 ft, abnd 6410 ft.

WEST TEXAS WILDCAT STARTS

Reagan County: Humble's Sawyer Cattle Co. 1, 1320 ft from n and 1650 ft from w lines T&P 13, blk 1, lcn Ordovician test.

Sterling County: Anderson-Prichard's Reed-Standard of Texas 1, c nw sw W&NW 8, blk 30, rur Ordovician test.

Ohio's Clark 1, c ne sw GC&SF 6, blk A, rur Ordovician test.

North Texas

Mississippian Discovery In Young County

Young County has new Mississippian discovery. Watson pool enlarged to northwest, and a new oil zone is promised. Montague County wildcat makes brief natural flow, and another may be junked without decisive test.

Young County: Standard of Texas and Hanlon-Buchanan's Donnell 1, west edge of county, 3½ miles nw of Murray, rated 3 to 5 bbls of oil hourly on swabbing test from broken saturation at 4466-4503 ft. Erecting tankage before acidizing. This wildcat passed up wet gas flow in Bend at 3830-49 ft.

Clay County: Whitaker Oil Co.'s Gragg 1, southwest outpost for Watson pool, indicated probably oil production from Strawn at 3655-76 ft, bottomed in shale at 3680 ft, and pipe run for completion. Roy Lee, trustee's Conrady 1, northwest extension, averaged 17 bbls of oil hourly for 6 hrs through 3/16-in, acidized perf at 5484-96 ft in Bend, topped at 5242 ft. Plugged back from water in Ellenburger 6027-31 ft. Sixth producer for Joy pool involved Shell's Brock 2, north outpost, flowing 616 bbls

through 2-in tubing, acidized Mississippi at 5917-6028 ft. Youngblood and Foree's Sanzenbacher-Gulf 1, 5 miles east by north of Halsell pool, was drilling lower Strawn shale at 5630 ft.

Montague County: Sinclair Prairie's Eanes 1, 6¾ mi southwest of Bowie, flowed 43 bbls the first hour and 4 bbls the next hour after being shut in to build up pressure. Acid will be used through Bend perf at 5912-22 and 5828-40 ft to try for sustained flow. This wildcat is 7 mi southeast of nearest pool. R. C. Lipscomb et al's Vaughn-Harmon 1, northeast corner of county, collapsed pipe while trying to squeeze at 3875-80 ft after testing dry. Rogers Bros. Drilling Co.'s Glass 1, mile northeast of Bowers pool and separated by failures, slated for new pool rating in flowing 624 bbls through ¼-in, sand at 2935-43 ft and sandy-lime pay at 2943-46 ft, total depth 2954 ft.

Wise County: Stanolind's Menasco 1, first producer for county, returning considerable rotary fluid on swabbing tests from Bend perf at 5790-5818 ft. Well capable of brief flow of oil when shut in for pressure build-up.

NORTH TEXAS FIELD COMPLETIONS

Archer County: L. T. Burns et al's McAnally 1, 990 ft from w and 330 ft from n lines blk 8, G. P. Meade Pasture subdiv, pump 37 bbls, sand 1443-48 ft.

L. T. Burns et al's Perrin 1, blk 7, G. P. Meade Pasture subdiv, abnd 1507 ft.

Clay County—Ross: Continental et al's Williams 1, 440 ft from n and 2514 ft from w lines 369-ac lse, Wm. Walker sur, Bend 5372 ft, flow 243 bbls, 25/64-in, acid 4000 gals 5372-5491 ft, td 5493 ft.

Montague County—Sanders: Sinclair Prairie's McCarty 1, 586 ft from n and 660 ft from w lines blk 114, J. C. Mattison sur, Viola 6196 ft, Ellenburger 6740 ft, abnd 6860 ft.

Throckmorton County: C. Coleman and F. S. Freeland's McKeichan 1, 1880 ft from s and 2650 ft from e lines sec 4, Comanche Indian Reserve, abnd 734 ft.

Wichita County—K-M-A Ellenburger: Fain-McGaha Oil Corp.'s Griffin 3-C-E, 1125 ft from s 1550 ft from e of n-200-ac lot 6, Spillers sur, flow 726 bbls ½-in, Ellenburger 4352-90 ft.

Wichita County: Akin-Dimock et al's Hardin 5, 2000 ft from s and 780 ft from e lines of O. Farrish sur A-383, abnd 1367 ft.

Hanlon & Buchanan's Burnett 16-A, H&GN 34, A-435, pump 10 bbls, sand 882-86 ft.

Young County: W. R. Worthington et al's Killian 2, 605 ft from n and 1210 ft from e lines TE&L 211, abnd 962 ft.

NORTH TEXAS WELL DEEPENED

Archer County: Producers Dev. Co.'s Roach 10, 1663 ft from w and 450 ft from n TE&L sec 1595, otd 1263 ft, pump 10 bbls, 1262-70 ft.

NORTH TEXAS WILDCAT COMPLETIONS

Archer County—Oil Discovery: Perry Browning et al's Browning 1, 330 ft out sec blk 89, L. P. Hunt-German Emigration Co. sur, elev 992 ft, Bend 5125 ft, Mississippi 5215-16 ft, Ellenburger 5216 ft, flow 585 bbls 41.6-gr, ½-in, acid 10,000 gals, Ellenburger 5220-5330 ft.

Denton County—Failure: C. H. Gannon Dr. Co.'s Aetna Life-McBride 1, 660 ft out swc R. W. Wright sur, Ellenburger wash 2050 ft, abnd 2217 ft.

Montague County—Oil Discovery: Continental's Hildreth 1, 856 ft from s and 509 ft from w lines ET 53, elev 1055 ft, Bend 6005 ft, Viola 6546 ft, Simpson 6790 ft, basal Simpson 7070 ft, Ellenburger 7240 ft, flow 329 bbls 40-gr, 30/64-in, acid basal Simpson 7160-7202 ft, td 7256 ft.

Wilbarger County—Failure: Frank Wood et al's Waggoner Est. 1, 2970 ft from e and 330 ft from n lines H&TC 16, blk 5, abnd 1880 ft.

NORTH TEXAS WILDCAT STARTS

Archer County: Bridwell Oil Co.'s L. F. Wilson 1-I, 330 ft from s and 990 ft from e lines ATNCL-Wilson sec 32, lcn 1650-ft test.

Cable Oil Co.'s Carter 1, 1470 ft from n and 330 ft from e lines ATNCL 96, lcn 1700-ft test.

Clay County: Continental's Spring 6, 3051 ft from e and 532 ft from n lines lot 26, but in lot 25, Marion CSL sur, spd 5600-ft test.

Jack County: Barnsdall-J. S. Youngblood-R. L. Foree's Garrison 1, 330 ft w and 1109 ft s of ne corner of T. Nash sur A-2021, lcn 6400-ft test.

TEXAS PANHANDLE COMPLETIONS

Gray County: Lefors Pet. Co.'s Bull 2-B, 1267 ft from n and 320 ft from e lines w-100-ac H&GN 3, blk B-2, pump 25 bbls oil, 25 wtr, shot 410 qts 2737-2835 ft, td 3060 ft.

Hutchinson County: J. M. Huber Corp.'s Mayfield 2, sw nw sw D&P 4, blk R-2, flow 2352 bbls on gas lift, acid 5000 gals 3228-36 ft, td 3270 ft.

John Turner et al's Cockrell 1-B, c n½ s½ nw M&C 2, blk Y, pump 10 bbls, shot 120 qts 3020-3060 ft.

WEST CENTRAL TEXAS FIELD COMPLETIONS

Taylor County—Merkel: Fain-McGaha Oil Corp.'s Perry 1-B, 990 ft from s and 330 ft from e lines subdiv 4, Grimes CSL, leag 124, elev 1785 ft, Dothan 1945 ft, flow 194 bbls, ¾-in, acid 1000 gals, 2573-95 ft.

WEST CENTRAL TEXAS WELL DEEPENED

Eastland County: Lone Star Gas Co.'s Groves 7, 2190 ft out nwc SP 487, elev 1509 ft, originally 62,500,000 gas otd 3575 ft, flow 81 bbls, 2-in, acid 1000 gals, 3912-23 ft.

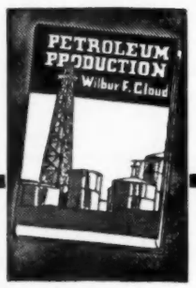
WEST CENTRAL TEXAS WILDCAT STARTS

Jones County: Merry Bros. & Perini's Lonnie Maxcey 1, 330 ft fro mw and 1391 ft from s lines of m/se 100-ac tr, T&P 4, blk 16, lcn 2500 ft test.

Palo Pinto County: Hickok-Reynolds-States Oil Corp.'s Allen-Ritchie 1, 1320 ft from m/s/n and 879 ft from m/e/e lines of M. E. Connaster sur A-1461, lcn 5500-ft test.

Shackelford County: I. R. McKee et al's A. Andrews 1, 660 ft from w and 330 ft from s lines of n-120-ac of w½ ET 14, lcn 1000-ft test.

PETROLEUM PRODUCTION



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East Texas

Bowie County Prospect Drilling in Cotton Valley

Bowie County prospect is in Cotton Valley series. Nacogdoches County wildcat proves dry in Pettit. Houston County gas-distillate strike given open flow test.

Bowie County: P. D. Bowlen and Grady Vaughn's Simms 1, 7 miles southwest of New Boston and 35 miles west by south of Smackover lime production in Arkansas, was drilling green shale at 7300 ft in Cotton Valley series, topped at 7075 ft, elevation 350 ft. Smackover objective due near 8200-8400-ft level.

Nacogdoches County: Texas Co.'s Strahan 1, 7 miles northeast of Nacogdoches, entered Pettit at 8020 ft and no shows in drilling to 8240 ft, elevation 447 ft.

Houston County: American Liberty Oil Co., successor to Russell Grimes et al, has given Ellis 1 an open flow rating of 30,000,000 ft gas with 12 bbls distillate per million ft. Production is from Woodbine perf at 5932-39 ft. This producer is 2 miles northwest of the Percilla pool's abandoned discovery, which originally made wet gas with water then converted into an oil well.

Wood County: Carter-Gragg Oil Co.'s Club 1, southwest outpost for Hawkins field, abandoned in Woodbine water sand at 4815-50 ft. Delta Drilling Co. et al's Goldsmith-Shell 1, 3 miles northwest of Quitman, failed to encounter shows in sub-Clarksville, and was drilling at 4280 ft. Amerada's Kennemer 1, northeast edge of Coke field, yielded water on "sample" perf at 6393-6403 ft, then squeezed to complete in main body of Paluxy, topped at 6342 ft.

Hopkins County: O. W. Killam et al's Smith 1, Wm. Adams Survey, abandoned in Paluxy water sand at 5629-5705 ft.

Hunt County: Iowa Payne Oil Co.'s Morrison-Humble 1, southeast edge of the Wieland 6-well pool, abandoned as water well in Woodbine at 2781-83 ft, making total of 6 failures within and adjacent to the pool since its discovery last June.

Cass County: Best producer out of five for the Kildare field was completed by C. C. Gilger at Cass County Fee 1, Watson survey. This well flowed 1500 bbls on ¼-in choke from perforations in the Gloyd lime at 6001-10 and 6015-22 ft. The well offsets another producer completed by Gilger, Grogan 1. On the north side of the field Rogers Lacy's Little 1, Watson survey, flowed 70 bbls of oil in 10 hrs on ⅛-in choke, with tubing pressure 1390 and casing pressure 1820 pounds.

Shelby County: An oil producer is indicated for the Joaquin gas field. On 15-hour drill stem test, Southern Production Co.'s Lambert 1, Pennington survey, showed 72 bbls of fluid, 66 bbls being 36-gr oil and the remainder salt water.

EAST TEXAS FIELD COMPLETIONS

Anderson County—Concord: Magnolia's Campbell 2, 467 ft from nw and e lines 90.22-ac lse, J. B. McNeeley sur, elev 554 ft, Austin 4290-4594 ft, Woodbine 4785 ft, Georgetown 4940 ft, abnd 5107 ft.

East Texas Field—Longview Area: Selby O&G Co.-Lewis Prod. Co.'s Snavely 26-A, W. Tyndale sur, elev 281 ft, top Woodbine 3593 ft, abnd 3625 ft.

Henderson County—Flag Lake: Harry Hines and Hancock's Dillard-Humble 2, 330 ft out nec 175-ac lse, H. Jeffries sur, elev 309 ft, pump 14 bbls, Woodbine 3020-23 ft.

Harry Hines and Hancock's Dillard-Humble 3, 660 ft from e and 330 ft from s lines 175-ac lse, H. Jeffries sur, pump 26 bbls, Woodbine 3001-04 ft.

Wood County—Coke: Amerada's Foster Unit 1, 467 ft out nwc 28.55-ac unit, Berry Smith sur, elev 518 ft, Paluxy oil sand 6244-6345 ft, flow 275 bbls ¼-in natural, Paluxy perf 6332-45 ft, td 6393 ft.

Wood County—Hawkins: Humble's Smith 4, 467 ft out nec 127.23-ac lse, W. Herrington sur, flow 169 bbls, ¼-in, Woodbine perf 4844-73 ft, td 4902 ft.

EAST TEXAS WILDCAT COMPLETION

Cherokee County—Failure: Magnolia's Braly 1, 486 ft w and 2400 ft s of nec of 101.86-ac lse, Josiah Thomas sur, ½-mi e Mixon, elev 403 ft, Woodbine 4260 ft, Georgetown 4886-5765 ft, Goodland 5830-6040 ft, Paluxy 6010 ft, 1st Glen Rose 6130 ft, Massive anhydrite 7740 ft, Jamestown 8400 ft, Pettit 8620 ft, Travis Peak 8829 ft, abnd 9006 ft.

EAST TEXAS WILDCAT START

Wood County: Magnolia's G. A. McCreight 1, 660 ft out nwc 87.7-ac lse, lot 7, Encarnacion Esparza sur, rur for deep test.

Southwest Texas

Gas Field Opened in Sarco Creek Area, Goliad County

New gas reserve opened on Sarco Creek prospect of Goliad County. Kohler discovery in Duval County pumps small amount oil and water.

Goliad County: Ginther, Warren & Ginther of Houston are completing Wood 1, wildcat discovery of Sarco Creek prospect, as a gas producer from perforations at 4170-80 ft. On official gauge the well flowed 180,000,000 gas daily through open pipe with a small amount of distillate. A previous test at same level, using ½-in choke, flowed considerable and some distillate with 1715 pounds pressure on tubing and 1740 pounds on casing.

Total depth is 5253 ft with 5½-in casing cemented to 4215 ft. Location is on east end of 500-ac lease in Domingo Morris survey, one mile northeast of previous dry holes in area. Operators are due to start operations on second well in area soon.

Duval County: Ogden & Voyles have been making tests on Richardson 1, wildcat southeast of south end of Kohler field. On last test the well pumped 27 bbls of fluid daily from perforations at 1780-94 ft in Cole sand, topped at 1763 ft. One third of the fluid, however, was water and remainder oil. This wildcat, located in GB&CNG 3, is one half mile southeast of Clark & Cowden's Richardson 2 discovery on south end of Kohler gas field. The hole is bottomed at 3004 ft with 5½-in casing cemented to 1824 ft for completion.

Wilson County: Superior Oil Corp. and Progress Petroleum Co. are reported still testing Gross 1, outpost one half mile southwest of Boysen 1, Wilcox discovery in Poth area. Operators swabbed down to 1600 ft, the well showing small amount of oil and gas. This well is bottomed at 4314 ft with 7-in casing set to 4250 ft, with 64 ft of open hole below casing. Operators logged sand showing oil in Midway at 4252-65 ft, while the Wilcox pay at Poth proper was found around 4100 ft.

Jackson County: Pan American is making a test in deep sand in Bigott 1, deep test on west flank Mayo field. Pipe was perforated at 6169-74 ft and 6146-48 ft and squeeze jobs made above and below a sand section that may open a new productive horizon. This well, located in Morris-Cummings survey 11, was drilled to 7613 ft after a test was made at 5398-5415 ft and showed gas and distillate.

LOWER TEXAS COAST FIELD COMPLETIONS

Bee County — South Caesar: Continental's Fox 2, 805 ft fr el & 467 ft fr nl of Charles Amsler sur, A-76, 172-ac lse, 5½-in 6580 ft, flow 360 bbls, 3/16-in, td 6583 ft.

Jay Simmons' Cotton 2, 467 ft fr nl & 591 ft fr el of 92-ac lse, Thomas Powell sur, A-267, 5½-in 6626 ft, perf 6618-23 ft, 301 bbls 3/16-in, td 6628 ft.

Jackson County—Mayo: Stanolind's Meyer 2, 467 ft fr n&wl's of 177-ac tr, T. H. Robertson sur, 5½-in 5520 ft, perf 5318-24 ft, 60 bbls, ¼-in, td 5528 ft.

Texas Co.'s Simicek 2, 467 ft fr s&el's of 165-ac lse, M. L. York sur 12, A-313, 5½-in 5517 ft, perf 5325-30 ft, 111 bbls, ⅛-in, td 5557 ft.

Jim Wells County—Seeligson: Shell's Seeligson 12, 1900 ft fr nl & 4997 ft fr el of 990-ac tr, Willis Millican sur, 335, A-291, 5½-in 5985 ft, perf 5954-74 ft, 154 bbls, 7/64-in, td 5985 ft.

Lavaca County—Brushy Creek: Shell's McManus 2, 660 ft fr nl & sw'ly swl of 1244-ac tr, Alexander Adams sur, A-69, 5½-in 7754 ft, perf 7710-45 ft, 100 bbls dist, 3,275,000 gas, ¼-in, td 8008 ft.

LOWER TEXAS COAST WILDCAT COMPLETIONS

Bee County—Failure: Stanolind's Gould 1, Bainville area, 660 ft fr ne & nwl's 354-ac lse, William Gill sur, A-166, abnd 9500 ft.

Hidalgo County—Failure: Baldridge & King and LaGloria Corp.'s Daskam 1, 660 ft fr n&wl's of lot 31, porcion 45, 4 mi ne Nichols field, abnd 4515 ft.

Continental's Young 1, 2970 ft fr wl & 2313 ft fr nl of 8863-ac tr in Manuel Gomez gr, A-63, abnd 10,201 ft.

Jackson County—Failure: George W. Strake's L. Ranch 1, 1887 ft fr sl & 660 ft fr e'ly el I&GN 25, A-154, abnd 7305 ft.

LOWER TEXAS COAST WILDCAT STARTS

Bee County: H. F. Wilcox Oil & Gas Co.'s Harris 2, Cadiz area, 541-ac lse, Cayetano Rivas gr, lcn 4500-ft test.

DeWitt County: Adams Oil & Gas Co.'s Pieper 1, Yorktown area, H. G. Woods sur 45, 103-ac tr, lcn 10,000-ft test.

SOUTHWEST TEXAS FIELD COMPLETIONS

Jim Hogg County—Colorado: Humble's East 2, 495 ft fr s'ly el & 730 ft fr s'ly sl of 1091-ac lse, lot 97, Las Moretas gr, set 5½-in 3133 ft, 198 bbls 3/16-in chk, td 3156 ft.

Zapata County—Glen: M. G. Jeffries' Hinnant 2, 111-ac lse, sur 307, temp abnd 3240 ft.

SOUTHWEST TEXAS WILDCAT COMPLETIONS

Jim Hogg County—Discovery: Sun's East 1-D, 3300 ft fr s'ly wl & 3300 ft fr s'ly nl of 4503-ac tr, s portion Santo Domingo de Arriba gr, 5½-in 4772 ft, perf 4740-41 ft, 8 bbls 51-gr, 3/16-in, td 5303 ft.

McMullen County—Failure: J. W. Gorman's Atkinson 1, 320-ac lse, AB&M 125, A-55, abnd 2763 ft.

Starr County—Failure: Otto Woods' Kelsey-Bass, 552 fr n&sl & 818 ft fr el of e-wo-ac of blk 9, 1080-ac tr, porcion 86, 5½-in 1960 ft, perf 1962-72 ft, reperf 1780-86 ft, temp abnd 1984 ft.

SOUTHWEST TEXAS WILDCAT STARTS

Duval County: Argo Oil Corp.'s Braslau 1, Tarancahaus area, 660 ft fr nw&swl J. Poitevent sur 137, lcn 4500-ft test.

Live Oak County: Continental's George West 1-A, 8 mi sw George West, 2310 ft fr nw & 990 ft fr swl of James L. Vaughn sur 467, 7714-ac tr, lcn 10,500-ft test.

Zapata County: Dulup Oil Corp.'s Ward 1, nw Mirando Valley area, 660 ft fr ne & nwl blk 6 of sur 613, 1250-ac tr, lcn 4500-ft test.

SOUTH CENTRAL TEXAS WILDCAT COMPLETIONS

Atascosa County—Failure: J. A. Hardcastle's Kingsley 1, Pleasanton area, 457-ac lse, Nancy McAda sur 1550, abnd 956 ft.

Bastrop County—Failure: Taylor Refining Co.'s Watterson 1, Red Rock area, 220-ac lse, Andrew May sur, abnd 3700 ft.

SOUTH CENTRAL TEXAS WILDCAT STARTS

Guadalupe County: James H. Eddy and Tom Bromley's Peter 1, Seguin area, 100-ac lse, Jesus Cantu sur, lcn Edwards lime test.

LaSalle County: L. V. Manry's Talbert 1, 10 mi s Los Angeles, 640-ac tr IGN 149, lcn 5600-ft test.

Williamson County: H. C. LeFors' Pfleuger 1, 300-ac lse, W. M. S. Barker sur, lcn 800-ft test.

Texas Gulf Coast

Two Wilcox Wildcats Make Production Tests

Tests continued on Wilcox discovery in Austin County. First tests made on new Wilcox wildcat in Montgomery County.

Austin County: Ohio Oil Co. made two sets of perforations to shut off salt water above and below the second sand to be tested in Kaechely 1, Wilcox wildcat that is opening a new field at Orange Hill. First test was made in perforations at 9293-9310 ft which flowed gas and distillate and some salt water. Next test is due to be made in the 9100-ft sand level which indicated possible production on electrical survey. Several horizons are due to be tested. Total depth of hole is 10,104 ft with 5½-in cemented to 9411 ft.

Montgomery County: LaGloria Corporation (Gray and Wolfe) is making first flow test on Grogan-Cochran 1, apparent discovery on Pinehurst prospect. Several sand sections in Wilcox are due to be tested. Total depth is 11,921 ft with 7-in cemented to 10,358 ft and 4½-in liner set to 11,903 ft. Operators originally drilled this test to 10,300 ft, and based upon showings encountered to this depth the well was drilled to present depth. The well is located in A. Prather survey, 3 miles southeast of Magnolia.

Wilcox Trend: John G. Mayo, Jordan Drilling Co. and Edwin M. Jones are preparing to drill Texas Long Leaf 1, Wilcox test on Hortense prospect, Polk County. This prospect has been worked extensively by various geophysical crews, and Gulf, Arkansas, and Rycade are supporting the test. Location is 660 ft fr n&el of 50-ac unit No. 6 out of ne part of I. D. Thomas survey. Projected depth is 6500 ft.

In Mercy field, San Jacinto County, Shell has completed another producer in Wilcox sand. Operator's Central Coal & Coke 2 flowed 168 bbls through ⅛-in choke from perforations around 8280 ft.

Also on Wilcox trend but in Lake Creek area of Montgomery County, Superior Oil is making additional tests in Damuth 1. Operators tested lower horizons in this well, but it failed to produce commercially. Latest perforations were made in Wilcox at 9242-48 ft. Other perforations were made at 11,825-40 ft and 11,862-68 ft, showing small amount of distillate and salt water.

TEXAS GULF COAST FIELD COMPLETIONS

Harris County—Dyersdale: Jack W. Frazier's Griffith 8, 20-ac unit, lots 7 & 8, Whitney Britton sur, sand 3490 ft, 46 bbls, ¼-in, gor 17,000-1, td 3511 ft.

Jefferson County—Stowell: Glenn H. McCarthy's and Brown & Wheeler's Prox 3, 100-ac tr, B. A. Vacocu lge, 5½-in 8700 ft, abnd 9500 ft.

TEXAS GULF COAST WILDCAT COMPLETIONS

Brazoria County—Failure: Amerada's Sullivan 1, Velasco area, 911-ac tr, M. Henry & A. Calvit surs, abnd 7210 ft.

Grimes County—Failure: Hunt Oil Co.'s Yeager 1, Iola area, 401-ac tr, A. H. Long sur, abnd 5345 ft.

San Jacinto County—Failure: Fain Drilling Co. and Clark & Cowden's Baldwin 1, 34-ac tr, S. Arnold sur, A-64, abnd 10,011 ft in Wilcox.

TEXAS GULF COAST WILDCAT STARTS

Harris County: Broderick & Gordon's Lobit 1, Addicks area, 506 ft fr ne&wl 40-ac unit, D. Middleton sur, lcn 7500 ft test.

South Louisiana

Second Test Made on Chenier Au Tigre Well

Second production test scheduled on Chenier au Tigre wildcat in Vermilion Parish. Wildcat on Pecan Island prospect drilling deeper.

Vermilion Parish: Two wildcats continued to hold interest with Union Oil Co. finding gas in first sand tested in Louisiana Furs 1, deep test bottomed at 11,985 ft in shale. Operators perforated at 11,582-86 ft, but the flow was all gas. These perforations have been squeezed off and operators will make next perforations higher. At least two more sands will be tested. This wildcat, located on Chenier au Tigre prospect, has 5½-in set to 11,690 ft.

The other wildcat is Humble's Louisiana Land and Fur 1, 34-16s-1e, Pecan Island prospect, is drilling deeper after setting protection pipe to 11,449 ft in shale. Operators are reported to have encountered gas sands that indicated production and possibly oil.

St. Mary Parish: Fifteen Oil Co. is sidetracking South Coast Corp. 3, well on south flank Charenton dome, after plugging back from 6825 ft to 6266 ft. This well is 1320 ft south of the deep sand discovery producer.

Acadia Parish: Attempts were made last week to control fire in Union Sulphur's Gueno Est. 1, wildcat in Branch area near Crowley. Drilled to 10,447 ft, the well blew out and burned wildly several days. The well, located in 51-8s-2e, is due to open a new field. Several companies are reported to have attempted to secure acreage in the area following the blowout.

East Baton Rouge Parish: William Helis has completed a well in deep sand area at University field with Nelson 13, 36-7s-1w, flowing 152 bbls through 7/64-in choke. Perforations were made at 9397-9406 ft. Total depth is 10,285 ft with 7-in set to 10,000 ft.

SOUTH LOUISIANA FIELD COMPLETIONS

Acadia Parish—Jennings: Stanolind's Crowley 123, 2396 ft se alg s'ly line from s'ly cor sec 43-9s-2w, abnd 7982 ft.

Evangeline Parish—Pine Prairie: E. J. Nicklos' Reed 3, 330 ft fr sl lse in sec 36-3s-1w, 7-in 7631 ft, perf 7585-97 ft, 288 bbls 5/32-in, td 7631 ft.

Gulf's Schlicher-Thomas 1, 574 ft w & 325 ft s of ne cor se ne 36-3s-1w, abnd 7318 ft.

Vermilion Parish—Whitelake: Union of California's Vigneax-Gastinel 1, start ne cor sec 17, go 660 ft s 1 deg 27 mins w alg el, th 660 ft w at ra in sec 17-15s-1e, abnd11,163 ft.

SOUTH LOUISIANA WILDCAT COMPLETIONS

St. Landry Parish—Failure: Stanolind's Haas 1, Palmetto area, sw 17-4s-6e, abnd 10,852 ft.

North Louisiana

Winn Parish Well Threatens to Blow Out

Blowout averted at recently completed gas-distillate well in Winn Parish. Deep well in Bellevue field abandoned.

Winn Parish: Shut in since opening a new distillate field near Calvin early in October, H. L. Hunt's Goodpine F-24, C SW SE, built up enough pressure to cut threads of cutoff valves and gas escaped for three days, but a serious blowout was averted. Gauges showed maximum capacity of 2500 and 2000 pounds. Bottomed in the Paluxy, the well is a strong wet gasser. Estimates of potential gas production range upwar from 10,000,000 cubic feet per day.

Bossier Parish: In the old Bellevue field, Phillips Petroleum Co. abandoned Kendrick 1, C NE SW 22-19n-11, at 9070 ft. Salt water was found in the Cotton Valley series at 6465-70 ft.

LOUISIANA FIELD COMPLETIONS

Caddo Parish—Caddo-Pine Island: Bering's Hurdle 2, 34-22n-16w, abnd, 2494.

Bell's Thigpen-Herold, 35-22n-16w, pump 40 bbls per day, td 2457.

Claiborne Parish—Haynesville: Phillips Silas 1, c ne sw, 12-23n-8w, initial production 35 bbls per hr, open flow, perf Pettit lime 5297-5312, td 5380.

Ohio Oil Co.'s Seegar 1, 473 ft n and 620 ft e from sw cor sec 3-23n-8w, elev 295 df, flow 124 bbls in 7 hrs, ¼-in, gr 35, perf 5315-29, 5375-84, 5000 gals acid, gor 225/1, td 5421.

LaSalle Parish—Elm Ridge: Carter-Phillip's Tensas Delta A-2, c se sw, 25-6n-4e, elev 54, flow 201 bbls in 24 hrs, ¼-in, 42.5-gr, cp 600, tp 300, perf 4572-75, td 4582.

Union Parish — Monroe: Interstate Natural Gas Co.'s Fee-120, 13-21n-3e, flow 8,784,000 ft, rp 900, td 2166.

Interstate Natural Gas Co.'s Fee-122, 12-21n-3e, flow 12,424,000 ft, rp 930, td 2195.

LOUISIANA WILDCAT COMPLETIONS

LaSalle Parish: Carter's Louisiana Delta C-1, c ne nw, 28-6n-4e, top Wilcox 3504, abnd 5870.

Webster Parish: H. L. Hunt's Bilbray 1, 5-23n-11w, 3300 ft e and 660 n of sw cor of sec 5-23n-11w, abnd 4433.

LOUISIANA WILDCAT STARTS

LaSalle Parish: H. L. Hunt's Sandlin Unit 1, c nw ne, 8-7n-3e, drill.

Grant Parish: Placid's Tremont Lumber Co. B-3, c se ne 9-9n-1e, drill.

Caldwell Parish: Placid's Louisiana Central Oil and Gas Co., 120, c nw sw 9-11n-3e, lcn.

Arkansas

New Gas Field Opens In Pope County

Northwest Arkansas wildcat opens gas field. Northeast Arkansas venture tops Nacatoch with show.

Calhoun County wildcat will test Smackover lime.

Pope County: Arkansas Louisiana Gas Co.'s Ladd-Strong 1, SW SW 22-10n-21w, was completed as a gasser from two sands, as yet uncorrelated. From a sand section at 2500 ft, the well made 17,000,000 ft per day with rock pressure of 900 pounds; and from another sand at 2800 ft, flow was 9,000,000 ft, with 995 pounds rock pressure. The wildcat is five miles north of the Tate's Island field and about 30 miles north of Russellville.

Clay County: In the Rector area, C. C. Alford's Gordon 1, SEc SE SE 22-19n-7e, showed heavy black asphaltic oil in the Nacatoch from 981-87 ft. It is waiting on pumping rig.

Calhoun County: Finding the Cotton Valley series dry at 3270 ft, Skelly's Calion 1, C NE SE 27-15s-14w, is headed for the Smackover lime, now drilling below 4850 ft in anhydrite.

ARKANSAS FIELD COMPLETIONS

Lafayette County — Midway: Southwood's Hodnett 2, c nw nw 18-15s-24w, flow 336 bbls 34-gr, ¼-in, perf 6372-87, td 6467 ft.

Southwood's Hodnett 3, c ne nw 18-15s-24w, flow 235 bbls 34-gr, 14/64 in, perf 6364-80 ft, td 6042 ft.

Lafayette County—McKamie: Ridell Petro-

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ARKANSAS WILDCAT COMPLETIONS

Calhoun County: H. L. Hunt's Furlow-Abbott 1, c sw sw 27-14s-14w, abnd 4992 ft.

Ouachita County: Magale's Parker-Daniel 1, c ne sw 17-13s-16w, abnd 3601 ft.

ARKANSAS WILDCAT STARTS

Bradley County: Placid Oil Co.'s Southern Lumber Co. 1, c ne se 11-16s-12w, lcn.

Columbia County: Roy Lee, tr's Pickler 1, c sw ne, 23-17s-21w, dr.

Hempstead County: Barnsdall's Schults 1, c sw ne 20-14s-25w, lcn.

Union County: Wheeless' Union Sawmill Co. 1, c sw nw 1-18s-12w, dr.

Bruce Anthony's Giles 1, c ne se 26-16s-14w, dr.

Mississippi

Franklin County Test Making State's Deepest

Now drilling below 10,150 ft, Amerada's Central Lumber Co. 1, C NW NE 10-7n-3e, Franklin County, will be carried to 10,500 ft, a new depth record for Mississippi. No shows have been reported.

Grenada County: Freeport Sulphur Co.'s Clark 1, 22-5n-9e, topped the Cap Rock at 2334 ft, encountering a show of heavy asphaltic oil at that level. The wildcat venture is drilling below 2680 ft.

MISSISSIPPI WILDCAT COMPLETIONS

Hinds County: Tidewater Associated's Moore 1, 12-6n-4w, Sparta 1438 ft, Wilcox 2835 ft, Midway 5548 ft, Eutaw 6760 ft, Lower Cretaceous 8830 ft, abnd 8996 ft.

Lamar County: Tatum's Fee 4, nw 13-2n-16w, abnd 4661 ft.

Stone County: Harry I. Morgan's University 2, c sw se 32-3s-10w, chalk 5800 ft, Eutaw 7058 ft, massive sand 8335 ft, abnd 8574 ft.

MISSISSIPPI WILDCAT START

Grenada County: Adams Oil & Gas Co.'s Avent 1, ne c 26-22n-4e, rig up.

ALABAMA WILDCAT START

Walker County: Superior Oil Co.'s Moss and McCormack 1, c sw se ne 14-14s-9w, rig up.

Rocky Mountain Area

Horse Creek Strike Starts Heavy Leasing

General Petroleum Corp.'s Horse Creek wildcat rated as Lakota sand discovery, and company is moving in for test half mile south. Start outpost test in old Notches field, Wyoming. Another test to determine south trend of Cut Bank shoreline starts.

Horse Creek: General's 78-31-G, SW SE SE 31-17n-68w, Horse Creek structure, 20 miles northwest of Cheyenne, swabbed 45 bbls in 1½ hours from Lakota sand with saturation from 5451-89 an 5490 to 5510 ft. Pumping equipment installed. Rig will be moved half mile south for company's 74-6-P (Whitaker patented land), C SW SE NE 6 16n-68w. The well is rated as a discovery of which considerable importance is attached. It is on northern rim of the Denver Basin and heavy leasing is underway covering a wide area in southeastern Wyoming and northeastern Colorado as a result.

Notches Start: Indicative of the greater demand on Wyoming for heavy oil to supply fuel markets, the old Notches field, near Casper, is being opened up and its three Tensleep wells shut in for the past several years are being put on production. Tri-Good Oil Co., which recently acquired producing properties at Notches, is moving in for Government 3, NE NW NW 10-37n-85w, step-out to the west.

Hagen Nose: A sixth wildcat to start this year in an attempt to determine a southwest trend to the Cut Bank shoreline is Fulton & Filan's Indian Allotted 1, NE NE SE 9-31n-7w, Pondera County, Montana. Wildcat is located on a block of Blackfeet Indian lands leased at auction the past July and embracing Sections 4, 9, 10, 11, 12, 15 and 16-31n-7w.

MONTANA FIELD COMPLETION

Glacier County—Cut Bank: Emerson Production Co.'s Tribal-209 1, sw ne ne 25-33n-6w, swabbing 85 bbls, Lower Cut Bank 3020-32 ft, shot with 60 qts, td 3040, elev 3698 ft.

MONTANA WILDCAT START

Pondera County: Fulton & Filan's Allotted Indian 1, ne ne se 9-31n-7w, Hagen Nose, spudding.

WYOMING FIELD COMPLETION

Fremont County—Circle Ridge: Continental's Shoshone-309 3, sw ne nw 6-6n-2w, bailing 240 bbls, Tensleep 283 to 310 ft, td.

Exploratory Work in Dakotas Continuing

Despite war conditions, oil exploratory work is continuing in the Dakotas this fall with four drilling rigs and four seismograph crews at work.

Three seismograph crews are operating in North Dakota and four drilling rigs and one seismograph crew are working in South Dakota.

Interest in oil activities which was centered during the summer on The Carter Oil Company's well in Oliver County, North Dakota, has now shifted abruptly southward to the Black Hills area in South Dakota where the four wells are being drilled.

The Carter Oil Co.'s North Dakota well, Semling 1, SE SE 18-141n-81w, Oliver County, was abandoned in September at 8850 feet after pre-Cambrian rock was encountered at 8831 ft.

Continental Oil Company's test hole on the Flint Hill structure, Chilsom anticline near Edgemont in Fall River County, South Dakota, SE SE NW 36-8s-3e was temporarily halted early this month in the Minnelusa sandstone at 2335 ft. It is expected to be carried to below 4000 ft. Manning & Martin, Denver, the drilling contractors, are using a large rotary rig. The well is in the same section as one drilled by H. L. Hollingworth in 1925 in which considerable oil was found at 2085 ft. Many believe the Hollingworth well could have produced commercially if modern cementing and acidizing treatment had been available.

Fall River County is also the site of another well on Hat Creek near Rumford, SE 5-11s-4e. Barry Annie, superintendent of the Hat Creek well, who moved in a larger rig this summer to replace one used last fall, said drilling will be carried to 5000 ft if necessary. The well is being drilled for a group of Denver promoters.

The other two wells are being drilled near Rapid City, north of the Fall River County locations.

Drilling of John Arp's Gingrass 1 test on Elk Creek in Meade County, north of Rapid City, SE NE 19-3n-7e, was resumed late in September after being shut down for several weeks while drillers sought additional rock bits. The well is being drilled by a syndicate of Wyoming oil men, headed by John Arp of Cheyenne. Stols Brothers of Denver are the drillers.

Drilling has also been resumed on

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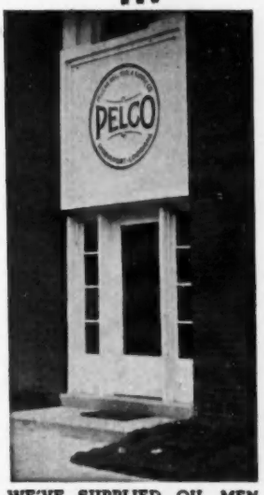

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A symposium conducted by the Research Committee of The American Association of Petroleum Geologists, A. I. Levorsen, chairman. Papers read at the Twenty-sixth Annual Meeting of the Association, at Houston, Texas, April 1, 1941, and reprinted from the Association Bulletin, August, 1941.

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Edited by A. I. LEVORSEN

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The purpose of this symposium is to get an over-all picture of the undiscovered oil resources of North America, north of the Rio Grande. Ten geological organizations have participated, to the end that this survey has behind it the authority of many geologists representing state and national geological surveys, large and small oil companies, and consulting and independent geologists. A map and a section of geology, stratigraphy, and structure illustrate each province description.

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the Black Gap structure in Pennington County, south of Rapid City, after a temporary shut down because of trouble with cavy formations in the Lakota. The well, known as Andrew et al's Miser 1, is located at NW NW 9-1s-8e. The hole has been drilled to about 800 ft. Started by Lem Johnston of Newcastle, Wyoming, last fall, it was taken over by Albert Andrews this summer. Ed Jewell of Wyoming is the driller. Some gas was encountered at around 300 feet.

Continental's well in Fall River County aroused the most extensive South Dakota leasing activity of the year along the Nebraska-South Dakota border with several large companies reported taking acreage in the area.

The Dakotas have been the scene of extensive leasing operations for the last three years. About 7,000,000 acres are under oil and gas lease in the two states. Investigating crews have been sent into the states during the last three summers by many of the larger oil companies.

The four seismograph crews, which are now operating in the Dakotas, represent: The Carter Oil Co., which is maintaining a crew in the Belle Fourche, S. D., area; The Texas Co., near Bismarck, N. D.; Amerada Petroleum Corp., out of Minot, N. D., and Standard of California, around Rugby N. D.

Crews representing several other firms worked in the two states during the summer, including Pure Oil Co., which worked out of Belle Fourche; Geotechnical Corp., of Dallas, headed by E. P. Kennedy, in the South Dakota-Montana border area, northwest of Belle Fourche; and Independent Seismograph Service of Fort Worth, in Grant County, N. D.

Scarcity of rubber and other war materials reduced the number of investigators coming into the Dakotas this year.

Drilling of deep water wells on three federal projects in South Dakota this summer has been watched carefully by oil men because of the geological information they provided.

A show of oil, encountered by water-well drillers in the Leo sand at the Black Hills ordnance depot in Fall River County was partially responsible for the oil play that section of the state has received this year.

A deep water well, being drilled at the Pierre air base project, near the center of South Dakota, is expected to reveal the nature of formations below the Sundance and to provide considerable light on geology of that region. The well will also check on the validity of magnetometer surveys which have been made by the South Dakota Geological Survey. Several gas wells are located in the Pierre area.

Two wells, one 3848 ft deep and the other 4645 ft, were drilled on the Rapid City air base project.

Interest in northwestern South Dakota and southwestern North Dakota, scene of much leasing activity a year ago because of the drilling of an oil well south of Baker, Mont., near the Dakota line, was somewhat revived this summer with the announcement by Carter that showings of oil were found in the well at four depths, 6815 to 6825 ft; 8320 to 8350 ft; 8455 to 8500 ft; and 8644 to 8659 ft. When the hole was acidized, swabbing produced 707 barrels of fluid in 96 hours, 23 percent water and the rest 27-gravity oil. The well was abandoned after the test.

California

Petrero-Newhall Area Test Indicates Producer

Outpost test successful in Potrero-Newhall field, Los Angeles County. Test scheduled for East Gato Ridge area, Santa Barbara County. Shallow test planned for Northwest Huasna area, San Luis Obispo County.

Los Angeles County: Formation test has indicated a successful outpost completion on the northern edge of the Potrero-Newhall field by Texas Co. in Newhall 1, 22-4-17. Bottomed at 8120 ft, formation test flowed 314 bbls daily, 30.5-gr oil, 40/64-in choke. Completion will add about three proven locations on northern edge of field, spacing on basis of 1 well to 10 acres.

Santa Barbara County: Location is being graded by General Petroleum Corp. for Giorgi 1, 13-8-32, East Gato Ridge area, a test for shallow heavy oil being planned.

San Luis Obispo County: Western Gulf has staked location for a test of the Northwest Huasna area, 35-31-14, present plans calling for a test of heavy oil possibilities around 600 ft.

CALIFORNIA FIELD COMPLETIONS

Fresno County—Coalinga Old Field: Shell's 7-32, 348 ft s, 922 w nec 32-19-15, pump 218 bbls 17-gr, 170 ft perf 2870 ft, td 2870 ft.

Kern County—Belridge South: General Belridge 3-37, 2084 ft n, 1820 ft w ¼c 3-29-21, pump 92 bbls 15-gr, 381 ft perf 851 ft, td 858 ft.

Kern County—Buena Vista Hills: Stanard's 102-35B, 1710 ft s, 2435 w nec 35-31-23, pump, no est 250 ft perf 3203 ft, Scalez 2613 ft, Wilhelm 2780 ft, Gusher 2860 ft, Calitroleum 3161 ft, td 3205 ft.

Standard's 103-15D, 2411 ft s, 2061 w nec 15-32-24, pump 38 bbls 30.6-gr, 67 ft perf 2882 ft, Pectin Owens zone 2862 ft, td 2884 ft.

Kern County—Kern Front: Standard's No. 29, c 15-23-27, pump 48 bbls, 154 ft perf 2363 ft, Chanac 2145 ft, "S" 2274 ft, td 2365 ft.

Kern County—Lost Hills: Universal Consolidated's No. 17D, 480 ft s, 2210 w nec 30-26-21, pump 114 bbls 16.9-gr, perf 805-1543 ft, oil-stained silt 900 ft, lower oil sand 1016-1125 ft, td 1545 ft.

Kern County — Midway Sunset: Bankline's No. 3, 990 ft s, 990 e n¼c 6-11-23, pump 55 bbls 17.8-gr, 125 ft perf 2200 ft, First oil zone 2063 ft, second zone 2100 ft, third zone 2152 ft, Etchegoin 2170 ft, td 2285 ft.

Kern County—Poso Creek-Premier: Standard's No. 3-8, 985 ft n, 989 w e¼c 8-28-27, pump 84 bbls, 118 ft perf 2899 ft, td 2900 ft.

Kern County—Round Mountain: Honolulu's No. 84, 220 ft n, 235 w e¼c 20-28-29, pump 36 bbls 19.6-gr, 332 ft perf 1934 ft, td 1950 ft.

Orange County — Yorba Linda: Shell's Olinda Fee 4-46-16, 3058 ft n, 2814 w c/ls Citrus & Eureka st, flow 381 bbls 20-gr, 48/64 in 27/200 lbs, perf 2443-2371 and 2310-2181 ft, td 2448 ft.

CALIFORNIA WILDCAT COMPLETIONS

Fresno County — Failure — Hanford Area: Continental's Drummond 1, swc 36-18-22, abnd 7897 ft.

Fresno County — Failure — Coalinga Area: Texas Co.'s Boychester 1, 18-21-15, abnd 3055 ft.

Kern County—Failure—Fruitvale Area: Petrolia Corp.'s Texaco 2, w¼c 26-29-27, Fairhaven 3343 ft, base Etchegoin 3372 ft, Parket 3430 ft, abnd 3658 ft.

Kern County — Failure — McKittrick Area: Union's Welport Fee 78-32, 330 ft n, 990 w sec 36-29-21, base Tulare 833 ft, 20 ft oil sand 950-1000 ft, 15 ft oil sand 1712-1727 ft, brown shale 1768 ft, abnd 2800 ft.

Los Angeles County — Failure — Castaic Area: Texas Co.'s Towle 1, 540 ft s 340 ft w c 3-4-17, abnd 7218 ft.

CALIFORNIA WILDCAT STARTS

Kern County: R. S. Miesse's Ham Johns 2, 32-12-18, spuded; Comanche Point area.

Tide Water's Sterling 1, 28-30-22, grading, McKittrick area.

Santa Barbara County: General's Giorgi 1, 13-8-32, lcn; Gato Ridge area.

San Luis Obispo County: Western Gulf's Huasna Comm. 1, 35-31-14, lcn; Huasna area.

Michigan

Deep Results Not Yet Encouraging Much Drilling

Deep tests to Richfield section of Monroe formation continue to dominate interest but still lack adequate results to encourage extensive development.

Missaukee County — Wildcat: After coring three pay zones in Dundee lime between 3200 and 4300 ft, Sun Oil Co. has resumed drilling to Richfield lime objective on State A1, 11-23n-5w. It will drill to 4500-4700 ft and plug back to Dundee after testing lower beds.

Roscommon County — Headquarters: E. V. Hilliard's State A5, Section 29-21n-3w, Roscommon Township, is flowing 39 bbls from 4950-60 ft in Monroe. Pay is about 200 ft shallower than that commonly classified as the "Richfield" and is differentiated by the high sulphur in the oil. Well is mile northwest of field and over three miles northwest of another deep well producing from same formation.

Freeman Oil Co. picked up the sulphur oil beds in the Monroe between 4750 and 4790 ft on Yeager 1, NE SE SE 25-20n-3w, Franklin Township, and shut down to install blower equipment to keep the foul gas out of the rig. Test is a semi-wildcat about three miles south of the field.

Mecosta County—Fork: Gulf abandoned Compson 1, S½ SE NE 6-16n-7w, diagonal northwest offset to the discovery, after drilling the Dundee dry at 3866 ft. It was first failure for new play and followed completion of a southwest offset producer to the discovery. Only two other wells drilling but offset requirements will bring at least three more starts.

Arenac County—Wildcat: W. L. McClanahan's Milligan 1, 31-9n-6e, Augres Township, under test for 10 days at 4180 ft, now being drilled ahead to 4250 ft. Well pumped up to 31 bbls oil dav from 4150-ft pay in Monroe but inability to pull 5-in set at 3900 ft forced abandonment of earlier production plans. Well was making considerable water between the casing point and the pay.

MICHIGAN FIELD COMPLETIONS

Arenac County—Adams: Smith Pet. Co.'s Allen 1, c sw sw 13-19n-3e, Dundee lime, dry, 3030 ft.

Basin & Rayburn's Demura 1, se nw 25-19n-3e, Richfield dolomite, pump 29 bbls.

Ervin Major's Klein 1, c ne se 25-19n-3e, Richfield dolomite, dry, 4645 ft.

Ervin Major's Adams 2, c se ne 36-19n-3e, Richfield dolomite, pump 39 bbls, 4270 ft.

Clare County — Winterfield: Taggart Bros. Co.'s Sample 107, c se 32-20n-6w, Stray sand, 4,900,000 gas, 1302 ft.

Taggart Bros. Co.'s Tope 108, c sw, 33-20n-6w, Stray sand, 7,010,000 gas, 1303 ft.

Lake County — Sauble: Swanson Con. Oil Co.'s Kragnes 1, ne sw sw 15-19n-14w, Traverse lime, dry, 2162 ft.

Mecosta County—Fork: Gulf's Compson 1, s½ se ne 6-16n-7w, Dundee 3861 ft, dry, 3866 ft.

Osceola County—Reed City: Louis Rose's Beecher 1, n½ ne sw 4-17n-10w, Monroe lime, swab and flow 68 bbls, 3510 ft.

Van Buren County—Muskrat Lake: James H. Conant's Banks 1, se sw se 11-1s-14w, Traverse lime, pump 50 bbls, 1299 ft.

MICHIGAN WILDCAT COMPLETIONS

Allegan County — Failure: Muskegon Oil Corp.'s Bala 1, w½ nw se 33-4n-12w, abnd 1604 ft.

Jacob Bolema's Thaler 1, sw nw se 11-4n-11w, abnd 1951 ft.

Calhoun County — Failure: Ashby Drilling Co.'s Paine 1, nw nw sw 12-2s-5w, abnd 2250 ft.

Isabella County — Failure: Union Drilling Co.'s White 1, ne ne se 5-13n-5w, abnd 3704 ft.

Van Buren County — Failure: R. Deem's Jung 1, se ne nw 18-1s-15w, Traverse 1150 ft, abnd 1156 ft.

Eastern States

NEW YORK COMPLETIONS

Allegany County: South Bolivar Oil Co.'s McKelvey farm, Bolivar, 8 bbls, Richburg, 1349 ft.

Nichols & Crowley's Wellman farm, Bolivar, 8 bbls, Richburg, 1555 ft.

Ebenezer Oil Co.'s Vincent farm, Scio, 10 bbls, Richburg, 1177 ft.

Bradley Prod. Corp.'s Sprague farm, Alma, 6 bbls, Richburg, 1349 ft.

Bradley's Rolls farm, Alma, 7 bbls, Richburg, 1340 ft.

Wm. Taylor Est.'s Breckenridge farm, Alma, 11 bbls, Richburg, 1422 ft.

Albert Oil Co.'s Witter farm, Alma, 9 bbls, Richburg, 1329 ft.

L. H. Thornton et al's Fassett farm, Willing, 7 bbls, Fords Brook, 1272 ft.

Scio Oil & Gas Co.'s Simerson farm, Scio, 7 bbls, Scio, 880 ft.

H. W. Patterson et al's Browning farm, Scio, 6 bbls, Scio, 750 ft.

F. J. Wilson's Brudick farm, Wirt, 6 bbls, Richburg, 1432 ft.

A. C. Shaner Oil Co.'s Childs farm, Clarksville, 6 bbls, Clarksville, 1323 ft.

Messer Oil Co.'s Koehler farm, Clarksville, 7 bbls, Clarksville, 1379 ft.

Sawnett Oil Co.'s Merritt farm, Genesee, 9 bbls, Richburg, 1480 ft.

NEW YORK INTAKE WELLS

Allegany County: South Bolivar Oil Co.'s McKelvey farm, Bolivar, Richburg, 1279 ft.

Cretekos & Vossler's Norton farm, Scio, Richburg, 1059 ft.

Otsquago Corp.'s Pike farm, Alma, Richburg, 1374 ft.

Bradley Prod. Corp.'s Crandall farm, Alma, Richburg, 1278 ft.

Albert Oil Co.'s Coats farm, Alma, Richburg, 1270 ft.

Trio Oil Co.'s Wetherby farm, Bolivar, Richburg, 1389 ft.

Nova Oil Co.'s Brown farm, Alma, Fords Brook, 1355 ft.

C. S. Christman & Son's Cass farm, Wirt, Richburg, 1410 ft.

OHIO COMPLETIONS

Ashland County: Ohio Fuel's Andress 1, abnd, 2786 ft.

Athens County: Kachelmacher Est.'s Head 1, 5 bbls, & 0.5 gas, 3455 ft.

Coshocton County: Blackburn et al's Miller 1, abnd 3506 ft.

Holmes County: Ohio Fuel's Collier 1, 0.12 gas, 2933 ft.

Knox County: Ohio Fuel's Hammond 1, 0.21 gas, 2745 ft.

Upham Gas Co.'s Wright 1, abnd 2463 ft.

Licking County: Penick et al's Banks 1, 0.09 gas, 2772 ft.

Loraine County: Edson & Son's Sznte 1, abnd 2428 ft.

Meigs County: Ohio Fuel Gas Co.'s Douglas 1, 6 bbls, & 0.01 gas, 1721 ft.

H. M. Nelson's Campbell 1, 0.06 gas, 670 ft.

Monroe County: Bauman et al's Young 1, 0.03 gas, 1922 ft.

Morgan County: Swingle et al's Weaver 3, 0.22 gas, 1162 ft.

Bern Oil & Gas' Bowman 1, 0.58 gas, 942 ft.

Muskingum County: Ohio Fuel's Wilson 1, 0.11 gas, 4055 ft.

Perry County: Preston's Yarger et al 1, 115 bbls, 3260 ft.

Pure's Pargeon 4, 65 bbls, 3355 ft.

Pure's Cannon 4, 0.05 gas, 1580 bbls, 3255 ft.

Stark County: Lyons Co.'s Brenner 1, 0.68 gas, 4798 ft.

Tuscarawas County: Ohio Fuel's Streb 1, 0.16 gas, 4557 ft.

Washington County: W. C. Metcalf et al's Ewers 1, 2 bbls, 1658 ft.

Wayne County: Preston's Piper 1, 45 bbls, 3207 ft.

PENNSYLVANIA COMPLETIONS

Greene County: Carnegie Nat. Gas' Phillips 1, abnd 3501 ft.

People's Natural Gas Co.'s Rinehart 1, 0.07 gas, 3543 ft.

Washington County: Foley & Williams' Clark 1, 0.26 gas, 1255 ft.

WEST VIRGINIA COMPLETIONS

Braxton County: Pittsburgh & W. Va. Gas Co.'s Howell 5, 8 bbls, 1500 ft.

Calhoun County: Hope Natural Gas Co.'s Summers 2-8627, 0.08 gas, 2063 ft.

Clay County: Pittsburgh & W. Va. Gas Co.'s Elk River 7866, 0.96 gas, 1898 ft.

Gilmer County: Mudlick Oil & Gas Co.'s Dent 1, abnd 2736 ft.

Jackson County: Columbian Carbon Co.'s Carney 3, 3.34 gas, 5308 ft.

United Carbon Co.'s Simmons 1060, 12.09 gas, 5282 ft.

Marshall County: R. W. Parriott & A. G. Iseminger's Moore 1, abnd 1690 ft.

Putnam County: Cooper Gas Co.'s Harper heirs, 0.12 gas, 2253 ft.

Carpenter Gas Co.'s Carpenter 2, 0.08 gas, 2125 ft.

Roane County: So. Penn Nat. Gas Co.'s Lynch 13, 10 bbls.

Upshur County: Cumberland & Allegheny Gas Co.'s Simons 326, 0.82 gas, 2081 ft.

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Men in the Industry's News

JAMES D. BASKIN, new chief supervisor of oil and gas for the Texas Railroad Commission, last week completed an inspection tour of district offices. So far the new chief supervisor has contented himself with investigation of the departments under his supervision and becoming familiar with details of the office. During this week he will complete his survey, and will include West Texas and Panhandle offices in his itinerary.

Oil men who have been in Austin to discuss problems with Baskin have been highly pleased with the sympathetic treatment they have received, it is said. They find Baskin has no time to quibble over technicalities so long as the proration regulations under his supervision are obeyed. Many of the operators believe that the change will end the harassing and inconsequential litigation with which they have been plagued during the past two or three months.

B. A. HARDEY of Shreveport, has been appointed a petroleum consultant on the OPC staff, it was announced October 29.

Hardey, chairman of the Louisiana State Mineral Board and formerly State Conservation Commissioner, will be stationed in Shreveport. The new consultant has had 28 years' experience in the oil and gas industries, for 11 years employed by Gulf Refining Company. He now owns a number of oil and gas properties. He is a director both in the Mid-Continent Oil and Gas Association and in the Independent Petroleum Association, and for some months also has served actively as a member of the OPC production committee for the Gulf Coast district.

G. H. WESTBY, president of Seismograph Service Corporation, Tulsa, spoke to Tulsa Geological Society, October 27, on "The Petroleum Industry and the Civil Air Patrol."

D. H. WAID, of the legal department of Sun Oil Company, Tulsa, is leaving for naval training as a lieutenant, junior grade.

RAY W. DIMIT, formerly petroleum engineer for Shell Oil Company, at Wichita Falls, Texas, has enlisted in the United States Naval Reserve and is located in New York.

J. B. MILAM, Claremore, was elected president; H. J. Whitehill, Tulsa, was elected secretary-treasurer, and D. G. Powell, Tulsa, was elected vice president; Herbert Gussman was elected head of the budget committee of Oklahoma Stripper Well Association in annual meeting at Tulsa, October 23.

ARNO BEHNKE, assistant superintendent of production for Amerada Petroleum Corporation in Fort Worth district and a veteran of World War I, has reported for duty with the U. S. Navy as a lieutenant in the administrative command.

F. B. HOWLAND, general manager of Kewanee Oil Company, is looking over the Mid-Continent area on a trip from his headquarters at Titusville.

GEORGE DUNLAP, of the land department of Sun Oil Company, Dallas, an engineer, has been commissioned an ensign in the Navy.

DR. H. D. WILDE, manager of technical and research department of the refinery department of Humble Oil & Refining Company, addressed the Houston Petroleum Electric Club, November 2, on "Production of Synthetic Rubber."

JAMES D. BALL, Humble Oil & Refining Company farm boss, has been transferred from the Government Wells, Texas, district to the Kelsey, Texas, district as assistant district superintendent.

WILLIAM T. POWELL has been appointed vice president of Emsco Derrick & Equipment Company, effective October 1, 1942. Powell was born in Treorchy, Wales, on December 22, 1901. He is a mechanical engineer; was graduated from the South Wales and Monmouthshire School of Mines in 1923, holds a mechanical engineering certificate of City and Guilds of London Institute, and is a member of the American Society of Mechanical Engineers.

Prior to 1929, when he came to the United States, Powell was associated with Bedwas Navigation Colliery Company as assistant chief engineer of that company's Bedwas mine.

He became a citizen of the United States in 1935 and, since taking up residence in this country, he has been associated successively with C. & A. Mining Company, Ajo, Arizona; Dicalite Company, Torrance, California; Kelco Company, San Diego, California, and American Potash & Chemical Corporation, Trona, California.

Powell entered the Emsco organization August 1, 1937, in the fabricated plate division. Since the beginning of the present emergency he has devoted his entire time to Emsco's effort in the production of war materials. He has been manager of the war materials division since that division was organized in June, 1941.

BLAKE CALDWELL has been advanced to position of manager in charge of all operations of the D + B Mid-Continent Division of Emsco Derrick & Equipment Company. He formerly was chief engineer of the D+B Division.

Caldwell was born in Gainesville, Texas, and is a graduate of the A.

& M. College of Texas, receiving the bachelor of science degree in engineering in 1927, and a master of science degree in 1929. He also has a three-year term as a member of the A. & M. faculty to his credit as a teacher of chemistry and engineering drawing. His early training was acquired as assistant engineer for the Gulf Refining Company of Port Arthur, Texas, and as engineer for the Tulsa Boiler & Machinery Company of Tulsa. Prior to his first connection with Emsco in 1940, he was chief engineer of Walter O'Bannon Company, Tulsa, for nine years.

While in Tulsa he was a charter member of the Tulsa Engineers' Club, and for the past 10 years he has been actively engaged in API standardization work. At present he is chairman of the subcommittee of rating hoisting tools, secretary of the manufacturers' subcommittee on pumps, and a member of the manufacturers' subcommittee on sucker rods.

L. H. KEIM, vice president in charge of West Coast operations of Oil Well Supply Company, has been transferred to the company's manufacturing headquarters at Oil City, Pennsylvania. Keim is a native of Pittsburgh, Pennsylvania, where he received his technical and practical training. In 1912 he became affiliated with the Westinghouse interests with various assignments, including that of mechanical engineer.

During the first World War, Keim assisted in designing and producing tanks and heavy ordnance, and after the armistice he was appointed general sales manager of the Nuttall division.

Nuttall and Oilwell collaborated in the design and development of special drilling equipment, after which Keim joined the Oilwell organization and was transferred to California. He was appointed general manager in charge of sales and manufacturing operations, and since 1929 has served as vice president.

SIDNEY SHUMAN has been appointed as general sales manager and John Ruff assistant manager of the Mid-Continent division by Fluid Packed Pump Company. Shuman joined the company in 1936 after having spent many years with Sinclair Prairie Oil Company. He has represented the company in the fields adjacent to Seminole, Shreveport, Smackover, Kilgore, Oklahoma City and Tulsa. He will continue to headquarter in the Hunt Building, Tulsa.

Ruff has been with the company for three years devoting his time to Texas fields. For 15 years prior to that, he represented Jarecki Supply Company in southern Kansas, northern Oklahoma, and Kilgore, Texas. Ruff will take up duties and headquarter at 6006 Navigation Boulevard, Houston.

Ora Frame, who formerly headed the company's southern division, is now in United States Marine Corps.

H. V. PUTMAN, manager of the company's transformer division, recently was elected vice president of the Westinghouse Electric and Manufacturing Company.

WILLARD G. WIEGEL, advertising manager of Lone Star Gas Company, Dallas, has been appointed personnel manager of the company and affiliated units.

R. H. NEWTON, general superintendent of Gulf Oil Corporation's properties in Venezuela, has returned to the United States and is visiting in Houston.

Squeaks from the Bull Wheel

What the Doctor Ordered

"Great Heavens! Who stuffed that towel in the patient's mouth?"

"I did, Doc. You said the main thing was to keep her quiet."

Down

"Could you get down off an elephant?"

"Sure, I'd climb down."

"Wrong."

"Then, I'd grease his sides and slide down."

"Wrong."

"Take a ladder and get down."

"No, not quite. You don't get down off an elephant; you get it off a goose!"

Explained

Johnnie was gazing at his one-day old brother, who lay squealing and yelling in his cradle.

"Has he come from Heaven?"

"Yes, dear."

"No wonder they put him out."

Small Portion

"And what will you have to drink?"

"Ginger-ale."

"Pale?"

"Good gracious no! Just a bottle."

The Thinker

"Darling, I could sit here and do nothing but look at you forever."

"Yeah, that's what I'm beginning to think, too!"

Court Action

What is your occupation?
I am an orderly in a hospital.
Thirty days for panhandling.

Opportunity to Grow

Client: "To be frank, you are too young to conduct my case."

Young Lawyer: "But sir, there is no knowing how long it will drag on."

Oil, Gas & Mineral Lease

On this, the blankety day of blank,
We deposit in the blank blank bank,
A bonus for you, if you sign this lease
(I'm warning you, if you do, you're geese).

The land this covers is all you've got
In whatever section, block or lot—
No doubt much more than you intended
That's good, my friend, we think its splendid.

You give us the right to dig and drill,
Build a house or erect a mill;
Or anything else we want to do
(If you sign this thing, I'm surprised at you).
If we don't start within a year
Another small sum in the bank will appear.
We can put you off for nine more times
By paying to you a few measly dimes;
But then at last your day has come
The drilling rig must begin to hum
Or else we give you back your lands
Still pregnant, no doubt, with thick oil sands.

If we drill a well and find some oil
One-eighth of all we get from your soil
Is yours in kind or else in money
At our option, of course—don't be funny.
But, listen to this—if we get only gas
I'm sorry for you, you poor old ass.
We can pay you fifty bucks per year
And hold the lease—now is that clear?
But, if, of course, the gas is sold,
We give you one-eighth (if **we** wish, in gold)
Or at our option, in kind at the well
But please remember, that's **if** we sell.

If a well comes in and is complete
As close to your land as a thousand feet,
We'll drill if you make us, but only when
You prove that it's draining your land, my friend.

Now, if we get in a real tight spot
We've plenty excuses, oh, quite a lot.
You've no doubt heard of force majeure
We needn't enumerate to you, I'm sure.
We've reasons for non-performance galore,
Insurrection, laziness, riot and war.
In other words, if you sign, you're sunk
You're an idiot, a sap, a dolt and a punk.

IN WITNESS THEREOF, on this happy day
(Happy for us alone, you say?)
When you've practically given us all your lands
We hereunto set our seals and hands.

A DEPLORABLE STATE
ANYOLE COUNTY

NOW my land I have kissed goodby,
I cross my heart and hope to die.
The above is the instrument I signed.
Today, sober, that's what I find.
But there ain't a thing in there I meant,
And this here's my acknowledgment.

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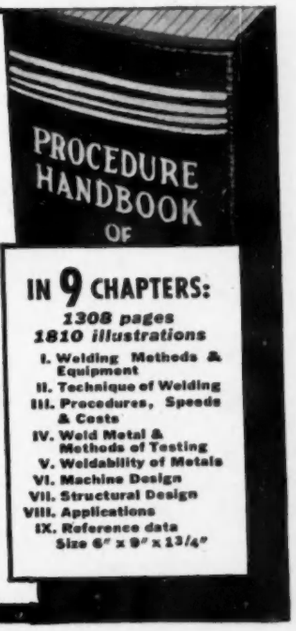

Notes for the Equipment Buyer and User

Welding Electrode

AIR REDUCTION SALES COMPANY

Air Reduction Sales Company has developed a new electrode designed specifically for all-position welding of mild steel with A-C type welding machines in following diameters: ⅛-inch and 5/32-inch.

Made to fill a rapidly growing need for a high quality A-C electrode for all-position use, the Airco No. 230 electrode complies with all requirements of the American Welding Society Classification E6011, American Bureau of Shipping, Group H1G and B1G for A-C and other specifications qualifying it for use on war work.

Physical tests demonstrate that this electrode gives exceptionally satisfactory results. The high quality of deposited metal of the No. 230 is fully comparable to that of the best D-C reverse polarity all-position electrodes.

Following are physical test results made on all-weld-metal tensile specimens:

Ultimate Tensile Strength, as welded, 70,000-75,000; stress relieved, 65,000-70,000. Percent Elongation in 2 inches, as welded, 25-30 percent; stress relieved, 30-35 percent.

An outstanding characteristic of this A-C electrode is that average operators have no difficulty in securing good fusion and complete penetration. The finished weld deposit is quite smooth and has a uniform surface contour.

Baker Oil Tools Awards Employes Service Pins

The California Division of Baker Oil Tools, Inc., presented service pins to its employes in recognition of 5, 10, 15 and 20 years of service, at Los Angeles, October 3. T. Sutter, executive vice president and general manager, acted as master of ceremonies.

One hundred and seventy-five employes were in attendance, and 100 service pins were awarded, including a special platinum and diamond founder's pin presented in turn to R. C. Baker by the employes.

R. C. Baker, Sr., presenting ten-year pin to R. W. Beals.

Baker, president and founder of Baker Oil Tools, Inc., is considered one of the oil equipment industry's pioneers and inventors. His history covers a span of 50 years, going back to 1893 when he first came to Los Angeles as a contractor-producer. In 1913 he founded the Baker Casing Shoe Company at Coalinga. Shortly thereafter the present corporation was formed, and in 1922 the company moved its headquarters to Los Angeles. Manufacturing plants and offices are now maintained at Los Angeles, Coalinga and Houston,

Many of the 52 former Baker employes, now in the armed forces, also earned service pins which the company is holding for them until they return from the war.

Honored guests for the evening included Captain George Serfass and Captain Joseph W. Campbell of the U. S. Army Ordnance Department.

A banquet and presentation ceremony will be held soon at the company's central division headquarters in Houston. Service pin awards will be made to employes there by C. E. Whitney, vice president and manager of Baker's central division operations.

Easy-to-read, *raised* black graduations on crack-proof white surface... resist abrasion from oil, sand, scraping on the pipe pile, etc. In all sizes and types—in cases or reels. Ask your dealer—or write for catalog.

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saves $35.00
on one trip

Engineer for one of the largest oil companies in the World advises that the saving in time alone on one of their largest drilling outfits more than pays for a Patterson-Ballagh Pipe Wiper.

"Before using the Wiper it took 2½ hours of circulation to get the mud back into condition. Based on a cost of $350.00 per day for well time, this figures $35.00 as the saving," he declares.
This does not include the saving in weight material which is that much more, nor insurance against dropping small objects into the well, nor the increased speed, due to a cleaner floor.

See Composite Catalog

PATTERSON-BALLAGH
PIPE WIPER

PATTERSON-BALLAGH CORPORATION
Los Angeles New York City
Houston

Well Equipment Employes Honored at Houston Dinner

C. K. Stillwagon, president of Well Equipment Manufacturing Corporation, recently gave a dinner at Houston to employes for their record of service and their contributions to the war effort. During the past year the company has shifted from a peacetime to wartime production.

Stillwagon, who acted as master of ceremonies and introduced guests and speakers, congratulated the employes for their cooperation and precision work which they are turning out on schedule.

Recognition was given, in the form of cash awards, to all employes who had gone 500 days without lost-time accidents. Mayor Neal Pickett of Houston awarded a safety flag to employes for their record, stressing the point that WECO and similar firms throughout the nation are important links in the chain of national wartime industry, and stated that it was a record to which other firms should aspire. Vic Norton, shop foreman, accepted the flag in behalf of the employes.

Rear Admiral P. W. Foote of the office of Inspection of Naval Materials for Texas, Arkansas, Louisiana, and Oklahoma, also presented to the employes a Minute Man flag of the United States Treasury in recognition of their record of 100 percent support of the program in investing 10 percent of their salaries in war stamps and bonds.

Admiral Foote commended the group for its "esprit de corps," and pointed out that common devotion of members to its organization was the underlying basis of success in any activity.

Judge William Pannill, attorney, Fort Worth, Texas, was the principal speaker, talking on "The Will to Victory."

Judge Pannill paid tribute to the women employes of the company who are operating turret lathes and other machines. "There will never be any suppression of women in the United States as exists under the Hitler regime," he emphasized.

Both vice president of the company, Howard Smith, and the secretary-treasurer, H. J. Hagn, were present at the dinner and had active parts in the program.

Guests of honor included Dr. Paul Best, company physician and safety program consultant and adviser, and Mrs. Best; E. K. Nold of the Aetna Life Insurance Company, and Mrs. Nold; Herman Brien, official of the Texas Foundries of Lufkin, and Mrs. Brien; L. M. Cole of Warner and Swasey Sales Company, and Mrs. Cole; Colonel Cal C. Chambers, president of the Texas Foundries of Lufkin, and Mrs. Chambers; Glenn Y. Davidson, the company's certified public accountant, and Mrs. Davidson.

Fittings

Bonney Forge & Tool Works, Allentown, Pennsylvania, has issued Bulletin WT31 telling how to make branch pipe outlets with Bonney fittings.

It tells in detail—their purpose; what they are; how to make right-angle welded branch pipe outlets stronger, better and at less cost; how to reduce turbulence and friction; how to make right-angle welded branch pipe outlets in six easy steps; their adaptability to every type of piping installation with numerous illustrations of various types of jobs on which they have been installed; their adaptability to manufactured goods and pre-fabricated piping as well as complete tables of specifications and dimensions.

It is recommended that any one using welding fittings or expecting to use them write the manufacturer for Bulletin WT31.

Above: Vic Norton, WECO shop superintendent, receives flag from Mayor Neal Pickett, as C. K. Stillwagon looks on. Top, right: Stillwagon and Rear Admiral P. W. Foote display the Minute-Man Flag. Bottom, right: Judge William Pannill addresses the honored group.

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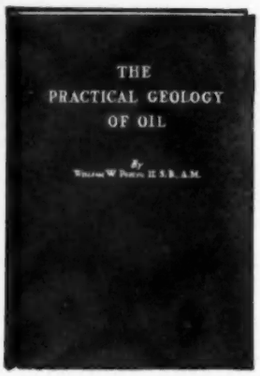

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